LEHIGH UNIVERSITY BULLETIN

Vol. I APRIL, 1902 No. 2

REGISTER

1901-1902

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Published Quarterly by

LEHIGH UNIVERSITY

SOUTH BETHLEHEM, PA.

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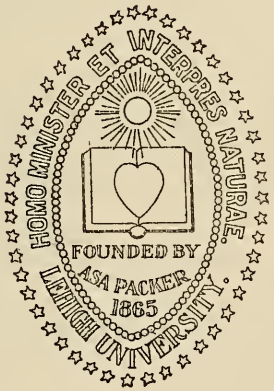

Published Quarterly by

LEHIGH UNIVERSITY

SOUTH BETHLEHEM, PA.

1901.

JULY.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
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AUGUST.

S	M	T	W	T	F	S
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4	5	6	7	8	9	10
11	12	13	14	15	16	17
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25	26	27	28	29	30	31
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SEPTEMBER.

S	M	T	W	T	F	S
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OCTOBER.

S	M	T	W	T	F	S
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NOVEMBER.

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10	11	12	13	14	15	16
17	18	19	20	21	22	23
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DECEMBER.

S	M	T	W	T	F	S
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1902.

JANUARY.

S	M	T	W	T	F	S
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12	13	14	15	16	17	18
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FEBRUARY.

S	M	T	W	T	F	S
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23	24	25	26	27	28	...
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MARCH.

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23	24	25	26	27	28	29
30	31	...	...	...	...	...

APRIL.

S	M	T	W	T	F	S
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13	14	15	16	17	18	19
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27	28	29	30	...	...	...
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MAY.

S	M	T	W	T	F	S
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11	12	13	14	15	16	17
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JUNE.

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JULY.

S	M	T	W	T	F	S
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AUGUST.

S	M	T	W	T	F	S
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SEPTEMBER.

S	M	T	W	T	F	S
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14	15	16	17	18	19	20
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OCTOBER.

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12	13	14	15	16	17	18
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NOVEMBER.

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DECEMBER.

S	M	T	W	T	F	S
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21	22	23	24	25	26	27
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1903.

JANUARY.

S	M	T	W	T	F	S
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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
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FEBRUARY.

S	M	T	W	T	F	S
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MARCH.

S	M	T	W	T	F	S
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APRIL.

S	M	T	W	T	F	S
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26	27	28	29	30	...	...
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MAY.

S	M	T	W	T	F	S
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17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
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21	22	23	24	25	26	27
28	29	30	...	...	...	...
...	...	...	...	...	...	...

CALENDAR.

1901–1902.

1901.

Sept. 21, 23, 24,	Examinations for Admission.
Sept. 25, 3.30 P.M.,	First Term begins.
Oct. 10,	Founder's Day.
Nov. 27, 12.30 P. M.,	Thanksgiving Recess begins.
Dec. 2, 8.15 A. M.,	Thanksgiving Recess ends.
Dec. 21, 12.30 P. M.,	Christmas Holidays begin.

1902.

Jan. 2, 2.00 P. M.,	Christmas Holidays end.
Feb. 10, 8.15 A. M.,	Second Term begins.
Feb. 22,	Junior Oratorical Contest.
March 26, 12.30 P. M.,	Easter Holidays begin.
April 3, 8.15 A. M.,	Easter Holidays end.
May 30,	Memorial Day (half holiday).
June 9,	Graduation Theses due.
June 15,	Baccalaureate Sunday.
June 16,	Class Day.
June 17,	Alumni Day.
June 18,	University Day.
June 19,	Summer Term begins.
June 19, 20, 21,	Examinations for Admission.

1902–1903.

1902.

Sept. 20, 22, 23,	Examinations for Admission.
Sept. 24, 3.30 P.M.,	First Term begins.
Oct. 9,	Founder's Day.
Nov. 26, 12.30 P. M.,	Thanksgiving Recess begins.
Dec. 1, 8.15 A. M.,	Thanksgiving Recess ends.
Dec. 23, 6.00 P. M.,	Christmas Holidays begin.

1903.

Jan. 5, 8.15 A. M.,	Christmas Holidays end.
Feb. 9, 8.15 A.M.,	Second Term begins.
June 17,	University Day.

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On leave of absence.

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215 Wall Street, Bethlehem.

ROBERT W. HALL, A.M., PH.D.,
Instructor in Zoölogy and Biology.
Duties begin September, 1902.

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Assistant in Chemistry.
76 Market Street, Bethlehem.

ERNESTO FRANCO, C.E.,
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237 Broad Street, Bethlehem.

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112 Second Avenue, West Bethlehem.

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Organist,
J. FRED WOLLE,
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LEHIGH UNIVERSITY.

ORIGIN.

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of $500,000, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the Lehigh Valley. On this foundation rose Lehigh University, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary, and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining, and Electrical Engineering, Metallurgy, Electrometallurgy, Chemistry, Geology, Physics, and in all needful collateral studies. A thoroughly equipped School of General Literature was also established, including the Classical and Latin-Scientific courses.

SITE.

South Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Reading (North Pennsylvania) Railroads, and the University buildings are about a half-mile from the station. New York is eighty-nine and Philadelphia fifty-seven miles distant.

The situation of the institution is healthful and beautiful. The region is famous for its mines and its railway and manufacturing enterprises.

TUITION AND OTHER FEES.

For students in the courses of Civil, Mechanical, Metallurgical, Mining, and Electrical Engineering, Electrometallurgy, and Geology, the tuition fee is $125 for the year or $75 for either term; for students in the courses of Chemistry and of Physics, $100 for the year or $60 for either term; for students in the School of General Literature, $60 for the year or $40 for either term. In addition there is a uniform charge of $5 for all students for the Department of Physical Culture.

Students entering the University during the year 1902-1903 will be required to pay a matriculation fee of $10. A graduation fee of $10 must be paid by all candidates for a degree.

The special fees for materials and apparatus used in the various laboratories, etc., are given in connection with the description of the course under the List of Studies.

The tuition fees are payable to the Treasurer of the University in two instalments. The first instalment, of $75, $60, or $40, according to the course, is to be paid to the Treasurer of the University on or before October 10; the second, of $50, $40, or $20, on or before February 20. A student who has withdrawn more than two months before the end of either term may make application for the return of a part of the tuition fee; but the amount thus refunded will in no case exceed one half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

The tuition fee of students entering the University in June, 1903, and thereafter in the departments of Civil Engineering, Mechanical Engineering, Metallurgical Engineering, Mining Engineering, Electrical Engineering, and Electrometallurgy will be $150. The Physical Culture fee and Matriculation fee will then be abolished.

POSTPONEMENT OF PAYMENT.

Students who give satisfactory evidence of the impossibility of paying tuition may have the privilege of postponing payment until after graduation or leaving the University. The recipient of this privilege signs a paper declaring it to be his intention to pay the amount of the tuition fees thus remitted in case he should ever be able to do so. He does not in this way accept a benefaction, but assumes a moral obligation which is individual

in character and does not affect any member of his family. A necessary condition of granting this privilege is that the applicant shall enter the University in full standing in his studies, and its renewal from year to year will depend on the maintenance of good scholarship and good conduct. This system of postponing payment supersedes the system of scholarships formerly in use.

PUBLIC WORSHIP.

Morning prayers are held in the Packer Memorial Church of the University, at which attendance is required.

Divine service is held every Sunday morning in the church. Any student who may desire to attend some other place of worship will be permitted to do so upon the request of his parent or guardian, or, if he is 21 years of age, upon his own request. The request for such permission should be renewed at the beginning of each year. Attendance, either at the Packer Memorial Church or at the church of his selection, is required of every student.

BUILDINGS.

PACKER HALL.

This building, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem, West Bethlehem, and South Bethlehem.

The department of Civil Engineering has, on the first floor, two drawing rooms and three lecture rooms, together with instrument rooms and offices. Here are found collections of bridge models, photographs and blue-prints, specimens of building materials, and also a large number of levels, transits, and other surveying instruments. The testing laboratory in the basement has four machines for tests of tension, compression, flexure, and torsion; a 2000-pound cement machine, and smaller apparatus for special experiments on beams and columns. The cement laboratory has recently been enlarged and its equipment made very complete. The Freshman drawing room of the Civil Engineering department is located on the fourth floor.

The second floor of this building is devoted to the class room and drafting work of the department of Mechanical Engineering.

Here are the various recitation rooms, and the well lighted and equipped drafting rooms for the several classes. Near these are the offices of the professor and instructors, the blue-print room, and the reference library of the department, with its large store of prints and working drawings. A wide range of machinery is illustrated by cuts and photographs on the walls. The drafting rooms are further equipped with an extensive assortment of machine parts in cases, with a full-sized link-motion constructed for Lehigh Valley Railroad practice, and with a small eight-wheel locomotive, which is an exact reproduction on a scale of one-sixth of a standard passenger locomotive.

On the third floor are to be found the lecture and laboratory rooms of the department of Mining Engineering and Geology. The Geological Laboratory is provided with eight Fuess petrological microscopes of high grade and the most recent pattern. About five hundred thin sections of rocks and minerals, and collections of recent shells and corals furnish material for undergraduate and graduate laboratory work. The lecture rooms are provided with typical sets of rocks and fossils for lecture purposes, and also with a stereopticon and micro-projection apparatus. The museum of Geology and Natural History and other class rooms are also on this floor.

This building contains also the lecture and recitation rooms of the departments of Greek, Latin, Modern Languages, and Mathematics.

THE CHEMICAL AND METALLURGICAL LABORATORIES.

This is a thoroughly fire proof building, built of sandstone, 219 feet in length by 44 in width, with a wing.

In the Chemical department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum, and laboratories for organic, physiological, agricultural, and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air pump for vacuum filtration, etc.

Photographic and microscopical laboratories are located in the third story of the central portion of the building.

The Metallurgical department contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals; a museum for mineralogical and metallurgical collections; a mineralogical laboratory provided with a Fuess reflecting goniometer, Goldschmidt's "two-circle" reflecting and application goniometers, a polariscope, a Groth's "universal apparat," and a Rosenbusch polarizing microscope; a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

THE LABORATORY OF PHYSICS AND ELECTRICAL ENGINEERING.

This building is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the dynamo laboratory, the work shop, a storage battery room, mechanical laboratory rooms (used by the department of Mechanical Engineering), and two research rooms.

The dynamo laboratory is equipped with a 50-horsepower engine, a Brackett cradle dynamometer, eighteen dynamos and motors ranging from 1 horsepower to 50 horsepower, nine small motors, an assortment of transformers, and a variety of measuring instruments and appliances.

A mechanician is regularly employed in the shop, which is well equipped for the repairing and manufacturing of apparatus.

On the second floor are the department offices, a reading room, apparatus rooms, and large laboratory rooms for general physics.

On the third floor are the physics lecture room with apparatus rooms adjoining, photographic and photometer rooms, a recitation room, and a large audience hall. A room on this floor is fully equipped for X-ray work in connection with St. Luke's Hospital.

On the fourth floor well lighted by dormer windows and skylights are three recitation rooms in the central portion of the

building, a large drawing room and a blue-print room in the east wing, and a museum room in the west wing.

STEAM ENGINEERING LABORATORY.

This is a new, well lighted, two story building of Potsdam sandstone, 90 feet long and 44 feet wide. It is divided into two sections, one for boilers and the other for engines. The former can accommodate three 100-horsepower high pressure boilers and the latter the various steam motors and their accessories. In this experimental power plant are contained a triple-expansion engine, a tandem-compound marine engine, a high-speed Ball engine (Erie, Pa.), coupled to a 25 K. W. Crocker-Wheeler generator, an Ingersoll-Sergeant Drill Co. air compressor which is compound at both air and steam ends, with reheating and cooling devices attached, and a DeLaval steam turbine that is combined with a centrifugal pump. The accessories are a Wilson-Snyder steam pump, a Blake pump, a Worthington circulating pump, a "Featherweight" air pump, a Cochrane feed-water heater and three Cochrane steam separators, also box-coil condensers, a Wheeler surface condenser, and Wainwright surface condenser. In addition there are water meters, weighing tanks, and dynamometers for measuring the steam consumption and the development of power.

In the basement of the Physical Laboratory an additional space of 2400 square feet is devoted to other experimental work, such as the calibration and application of all the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors and other prime movers than steam engines. In this section there are 4-cycle and 2-cycle gas engines, hot-air pumping engines, electric motors, a water motor, a 15-horsepower centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

SAUCON HALL.

Extensive alterations to this building were made in 1896, adapting it to the needs of the departments of English, of History and Economics, and of Philosophy. It contains a study and a recitation room for each instructor, a lecture hall seating 220 persons, and a large room on the ground floor which has been fitted up for the use of the Debating Society, with committee rooms adjoining.

CHRISTMAS HALL.

In this building are found the drawing rooms of the Metallurgical department and the halls of the Young Men's Christian Association. On the ground floor is a Supply Bureau conducted by students of the University.

THE SAYRE OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an astronomical observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the observatory is mounted an equatorial telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a sidereal clock, by Wm. Bond & Sons; a zenith telescope, by Blunt; and a field transit, by Stackpole. There is also a prismatic sextant, by Pistor & Martins.

Students in practical astronomy receive instruction in the use of the instruments and in actual observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

THE PACKER MEMORIAL CHURCH.

The Packer Memorial Church is the munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is one of the largest and most magnificent churches in the State.

THE UNIVERSITY LIBRARY.

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than $20,000 was contributed by her family and friends as a memorial fund for the purchase of books.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior the center is occupied as a reading space, 50 by 40 feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fire-proof, well lighted, and heated by steam.

One hundred and twelve thousand volumes are now upon the shelves, including many extremely valuable books. The list of periodicals numbers about two hundred and fifty, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

The Eckley B. Coxe Memorial Library.

In memory of the Honorable Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe has presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

THE GYMNASIUM.

The Gymnasium is a spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus and two bowling alleys, and is provided with hot and cold water, and shower baths, and 500 clothes closets.

EXPENSES.

Books, materials, paper, pencils, materials used in the laboratories, and drawing instruments are furnished by the student. Materials consumed in the laboratories can be obtained from the University, their value being covered by a deposit or fee made at the opening of that term in which the laboratory work is to be done. These fees and deposits for the various laboratories are given under the detailed statement of laboratory courses in the List of Studies.

Rooms and board cannot be had in the University buildings, but can readily be obtained in many private houses in South Bethlehem and Bethlehem.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $350 to $500. This includes attendance at the required summer schools.

Fee for Special Examinations.—Special examinations, granted by the Faculty to students at their request, are subject to a fee of five dollars, which is added to the President's Fund for the aid of indigent students.

ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the Registrar if information is desired which is not given in the Register.

DATE OF EXAMINATIONS.

Examinations for admission to the University will be held in 1902 on Thursday, Friday, and Saturday, June 19, 20, and 21, and on Saturday, Monday, and Tuesday, September, 20, 22, and 23. All applicants must be in attendance at 8:30 oclock on the morning of the first day.

The examinations are held in June and September in the following order:

First Day.—Geometry, 8:30 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

Second Day.—Algebra, 8:30 A.M.; English, 2 P.M.

Third Day.—Trigonometry, 8:30 A.M.; American History, 11 A.M.; German or French, 2 P.M.; Greek and Greek History, 2 P.M.

Examinations are also held for admission to the Freshman Class at the beginning of the second term and for admission to the Sophomore Class at the beginning of the first term; information as to these examinations may be obtained from the Registrar.

The examinations cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age, and must present a testimonial of good moral character from his latest instructor, or from some reputable citizen of the community in which he lives.

The Entrance Examinations set in June 1901 will be found on pages 115 to 129 of the Register.

THE SCHOOL OF GENERAL LITERATURE.

THE CLASSICAL COURSE.

Candidates for admission to the classical course are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of sentences; and (*b*) *Rhetoric* and *Composition.* Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

History.—This requirement includes: (*a*) *Greek History* to the death of Alexander, with due reference to Greek life, literature, and art. (As in Botsford, Myers, or Oman, with Mahaffy's Old Greek Life); (*b*) *Roman History* to the accession of Commodus, with due reference to literature and government. (As in Myers's Rome or Allen's History of the Roman People, pp. 1-242, and in Preston and Dodge's Private Life of the Romans); (*c*) *American History*, with the elements of civil government. This includes colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in Channing, McMaster, Thomas, or McLaughlin). Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Plane Geometry.*—Fundamental principles. Rectilinear fig-

ures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of metric units.

5. *Latin Grammar.*

6. *Caesar*, four books of the Gallic war.

7. *Cicero*, six orations, including the four against Catiline.

8. *Vergil*, the first six books of the Aeneid, including Prosody.

9. The translation, at sight, of passages from Caesar and Cicero.

10. The translation of English into Latin.

11. *Greek Grammar.*

12. *Xenophon*, Anabasis, four books.

13. *Homer*, Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

14. The translation, at sight, of a passage from some work of Xenophon.

Candidates for admission to the Classical Course who have had, in their preparatory schools, no opportunity of studying Greek, are, at present, admitted to that course in full standing upon presenting an amount of German or French equivalent to two years' work. They will begin Greek in the University and study it throughout the course.

THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first ten of the above requirements, but substitute for the Greek sections (numbers 11-14 inclusive) the following work:

15. *Solid Geometry.*

16. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles.

17. Two Years' Work in either *German* or *French.* This requirement will be satisfied by the completion of an amount of German equivalent to Part I of Joynes-Meissner's or Calvin Thomas's Grammar, and Buchheim's Reader, Part I, together with about 500 pages of standard German authors; or, if French is offered, an amount equivalent to Whitney's Practical Grammar and Super's Reader, together with about 800 pages of modern French authors.

The candidate is expected to have acquired the ability to read German or French prose and poetry of ordinary difficulty. His proficiency will be tested by questions on Grammar, by translation of simple English sentences into German or French, and by translations at sight of passages containing no rare or unusual words.

THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining Engineering, Metallurgy, Electrometallurgy, Electrical Engineering, Chemistry, Geology, and Physics are examined in the following subjects:

1. *English.*—This requirement includes: (*a*) *English Grammar*, especial attention being given to the analysis and correction of sentences; and (*b*) *Rhetoric* and *Composition*. Any High School Rhetoric, such as those of Hart, Hill, Williams, Kellogg, and others of a like grade, will be sufficient, together with practical exercises in composition.

Greater stress will be laid, year by year, upon accurate and idiomatic use of the vernacular, upon correct punctuation, clearness and facility in expression and in the presentation of ideas, an acceptable style in writing—in short, upon all that may fairly be expected of the student as the result of a thorough and intelligent preparation in English. To gain this end, it may be well to use the list of books suggested by the Joint Committee of Colleges and Preparatory Schools for admission to the colleges of the Middle States. From one of the last four books in their list a theme will be taken for the composition which forms a part of the examination paper.

It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *American History*, with the elements of civil government. This will include colonial history, with a view to the origin and development of our institutions, and the period of discovery and early settlement, so as to set forth the relations of peoples in America and the meaning of the struggle for mastery. (As in Channing, McMaster, Thomas, or McLaughlin.) Throughout this examination special emphasis will be laid on knowledge of the physical and political geography of the countries concerned.

3. *Algebra.*—Fundamental principles. Factoring. Least common multiple. Greatest common divisor. Fractions. Involution. Evolution. Radicals. Imaginary quantities. Equations of the first and second degrees. Ratio. Proportion and progressions.

4. *Geometry.*—Fundamental principles. Rectilinear figures. The circle. Proportional lines and similar figures. Comparison and measurement of the surfaces of rectilinear figures. Regular polygons. Measurement of the circle. Maxima and minima of plane figures, and plane and polyhedral angles. Solid geometry.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric units.

5. *Plane Trigonometry and Logarithms.*—Through the solution of right and oblique triangles.

6. *Elementary Physics.*—This requirement may be met by a good course in any of the standard High School text-books in Physics, such as Gage's Elements of Physics, Carhart and Chute's Physics, or Avery's Elements of Natural Philosophy. Ability to solve simple numerical problems is required. In case the candidate has done laboratory work in Physics he should submit his laboratory note book at the time of his examination for entrance.

7. *German.*—This requirement will be satisfied by the completion of an amount equivalent to Part I of Joynes-Meissner's or Calvin Thomas's Grammar, Buchheim's Reader, and additional reading.

[An equivalent amount of French will be accepted in cases in which it is inconvenient for the candidate to offer German. The amount thus required in French is equivalent to Whitney's Practical Grammar and Super's Reader, with additional reading.]

The candidate is expected to have acquired the ability to understand simple German (or French) prose, by the careful reading of about two hundred duodecimo pages, in addition to the study of Grammar. His proficiency will be tested by questions on the rudiments of grammar, by translations of simple English sentences, and by translations at sight of passages of easy German (or French) prose, containing no rare words.

DIVISION OF EXAMINATIONS FOR ADMISSION.

Candidates for admission to the Freshman Class may pass all the examinations in June, or all in September, or some in June

and the rest in September of the year of entrance, or may take them in *two consecutive years*. In the last case, for all courses candidates may present themselves for examination in the first year in the following subjects: Plane Geometry, English, and History. In addition, candidates for the Classical and Latin-Scientific Courses may present Latin: Grammar, Caesar, Cicero; and one of the following: (*a*) Greek: Grammar and three books of Anabasis; (*b*) German: the equivalent of one year's work; (c) French: the equivalent of one year's work.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

SPECIAL STUDENTS.

Mature young men who do not desire to take a full regular course, may select special courses, with the approval of the Faculty.

ADMISSION TO ADVANCED STANDING.

Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class. The additional subjects may be found in the schedule of studies of the different departments.

Students from other colleges will be admitted without entrance examinations, and their standing will depend upon the work which they have satisfactorily completed. But owing to the absence of uniformity in college courses, the class assignment cannot always be determined on this basis. A personal conference with the head of the department concerned is necessary in order that the student's course on entering the University may be arranged.

ADMISSION TO GRADUATE COURSES.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Courses.

PREPARATORY SCHOOL CERTIFICATES.

The University has no permanent arrangement with any preparatory school whereby certificates are accepted in lieu of entrance examinations, and the acceptance of certificates for any student in any subject must be the result of a special arrangement between the Principal of the school and the Registrar of the University. It is, however, regarded as highly desirable that the examiners should receive from principals of preparatory schools statements with reference to those whom they send as candidates for entrance, indicating as clearly and fully as possible, in each case, the teacher's opinion of the candidate's character and scholarship and fitness for entering upon collegiate work; and such statements will receive careful consideration, in connection with the results of the entrance examinations.

EXAMINATIONS AT SCHOOLS.

When desired by the Principals, arrangements will be made to hold at the schools the June examinations for admission to the University.

LIST OF STUDIES.

Following is a complete list of studies offered by the University in its various courses. The number of exercises per week in each subject is indicated by the figure in parentheses. Two hours of drawing, three of work in the laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

GRADUATE COURSES.

The degree of Master of Arts is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Arts at any College or University, shall pursue for at least one year at this University a course of liberal study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

In exceptional cases graduates of this University who are candidates for the degree of Master of Arts may be allowed to study in non-residence.

The degree of Master of Science is conferred upon any candidate, otherwise properly qualified, who, after having taken the degree of Bachelor of Science or a degree in technology at any College or University, shall pursue for at least one year at this University a course of advanced study in two departments (under two professors), pass the examinations of the same, and present a satisfactory thesis.

The tuition fee is $50 a year and the diploma fee is $10. No tuition is charged to students pursuing graduate work in non-residence, but the diploma fee is $30, and at least two years are required to complete the course.

The course of study may be selected, with the approval of the Faculty, from the following list of subjects, at least fifteen exercises per week being chosen in two departments. About two-thirds of the work is to be in one department and about one-third in another, these being called major and minor departments. The thesis is to be prepared on a subject connected with the studies of the major department. The candidate is required

to satisfy each professor that he is fully competent to pursue the subjects selected.

The following subjects are now offered by the University; other allied subjects may in some cases be selected by candidates after conference with the professors in charge.

Candidates who expect to receive the Master's degree in June of 1903 are required to confer with the professors on or before September 27, 1902, and to present their courses of study to the Faculty for approval on September 29, 1902.

IN SANITARY SCIENCE.

The Mechanical, Chemical, and Biological Purification of Water and Sewage.

PRESIDENT DROWN.

A critical chemical and biological study of the results of recent investigations that have been carried on in Europe and in this country into the methods proposed and those in use for the removal or destruction of the organic and inorganic impurities of water and sewage whereby this department of sanitary engineering has been put on a scientific basis. Two terms. (4)

IN CHEMISTRY.

Advanced Industrial Chemistry.

PROFESSOR CHANDLER.

This course involves the study of some industry dependent upon chemical principles and consists of practical experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms. (10)

The Rare Elements.

MR. SPANUTIUS.

The study of the properties and reactions of these elements and the preparation of some of their salts. Two terms. (10)

Advanced Organic Chemistry.

DR. SCHOBER.

This course consists of original investigations in organic chemistry. Two terms. (10)

ADVANCED INORGANIC CHEMISTRY.

DR. ULLMANN.

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms. (10)

IN MINERALOGY.

GEOMETRIC CRYSTALLOGRAPHY.

ASSISTANT PROFESSOR RICHARDS.

The course comprises advanced study in mathematical crystallography, including stereographic and especially gnomonic projection, with the theoretical views of crystallogeny developed by the latter. Further, practical crystal measurements with the two-circle or theodolite goniometer of Goldschmidt, projection of results gnomonically, and discussion of crystallographic constants thus determined. First term. (5)

PHYSICAL CRYSTALLOGRAPHY.

PROFESSOR FRAZIER.

This course consists of a description and discussion of the physical properties of crystals, especially their optical behavior. Works of reference: Mallard's Crystallographie Physique, Groth's Physikalische Krystallographie, and Liebisch's Physikalische Krystallographie. In addition, practical instruction is given in the determination of the optical constants of crystals. Second term. (5)

IN CIVIL ENGINEERING.

SANITARY ENGINEERING.

PROFESSOR MERRIMAN.

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms. (4)

BRIDGE DESIGN.

PROFESSOR MERRIMAN.

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparisons of different types. Two terms. (4)

Testing of Materials.

PROFESSOR MERRIMAN AND MR. DUFOUR.

The properties of materials of construction, with special reference to inspection and testing. The student will conduct original researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials will receive detailed attention. Two terms. (5)

Railroad Engineering.

PROFESSOR MERRIMAN.

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with the detailed discussion of special cases. Two terms. (2)

IN MODERN LANGUAGES.

German.

PROFESSOR RINGER.

An advanced course in the German language and literature, consisting of historical and advanced grammar, and reading. The course will be arranged with each candidate individually upon application. Two terms. (5)

French.

PROFESSOR RINGER.

An advanced course in the French language and literature, consisting of historical and advanced grammar, and reading. The course will be arranged with each candidate individually upon application. Two terms. (5)

IN GEOLOGY.

Geology.

PROFESSOR WILLIAMS.

The identification of rocks and the tracing of boundary planes under capping; the value of fossils in determining zones; the construction of maps and sections; and practice in taking field notes. Field work is done in the vicinity of the University, where formations from the Archaean to the Triassic outcrop and where glacial deposits cover the regions to the north. Second term. (6)

Physiography.

ASSISTANT PROFESSOR BARRELL.

The classification of land forms; their stages of development; their value as indicators of the geological history of the land; their dependence on climatic and geographic distribution. Lectures, assigned readings and studies in the field. Preparation required: 165 or 166 and 167. First term. (3)

Paleontology.

DR. HALL.

The study of the characteristic genera of fossil animals in detail, their structure, relationship, and geological range. Lectures and laboratory work. Preparation required: 176. 177 will be found advantageous.

Vertebrate Embryology and Organology.

DR. HALL.

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate will be carefully followed, beginning with the segmentation of the egg and tracing the history of the germ-layers, organs, and tissues. The organology deals with the association of tissues to form organs. Preparation required: 176, 177 and 177a. First term. (3)

IN MATHEMATICS AND ASTRONOMY.

Practical Astronomy.

PROFESSOR THORNBURG.

The work embraces: (*a*) The study of the instruments and methods used in the determination of time, latitude, longitude, and azimuth; (*b*) Practical work in the observatory, securing facility in making and reducing observations. Two terms. (4)

Analytical Mechanics.

ASSISTANT PROFESSOR MEAKER.

This course is based on Ziwet's Theoretical Mechanics and Routh's Dynamics of a System of Rigid Bodies. Two terms. (3)

Differential Equations.

ASSISTANT PROFESSOR LAMBERT.

The course in Differential Equations is based on Johnson's Differential Equations and Byerly's Spherical Harmonics. Collateral reading in the University Library is required. Two terms. (3)

IN ENGLISH.

English Literature.

PROFESSOR THAYER.

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms. (5)

IN PHYSICS AND ELECTRICAL ENGINEERING.

Theoretical Physics.

PROFESSOR FRANKLIN.

This embraces: (*a*) The theory of heat, based upon Preston's Theory of Heat and Buckingham's Thermodynamics; (*b*) The theory of electricity and magnetism, based upon Maxwell's Treatise, J. J. Thomson's Recent Researches, and Webster's Electricity and Magnetism; (*c*) The theory of light and sound, based upon Preston's Theory of Light and Helmholtz's Tonempfindungen. Two years. (4)

Theory of Alternating Currents.

PROFESSOR FRANKLIN.

This course is based upon the works of Bedell and Crehore, of Steinmetz, and of Franklin and Williamson. Two terms. (2)

Physical Research.

PROFESSOR FRANKLIN.

This course consists of original investigations in experimental physics. Two terms. (3)

Electrical Testing.

PROFESSOR FRANKLIN.

This course consists of investigations in electrical engineering. Two terms. (3)

IN PHILOSOPHY.

Philosophy.

PROFESSOR STEWARDSON.

Introspective and physiological psychology. The History of Philosophy in general together with special study of either the Greek, German, or English philosophers. Two terms. (5)

IN HISTORY AND ECONOMICS.

Political Economy.

PROFESSOR STEWART.

This course embraces: (*a*) The rise and development of economic systems and economic thought; (*b*) The scope and method of political economy. Patten's Development of English Thought and the works of Keynes, Cohn and Ingram on Political Economy will be used. Two terms. (5)

American History.

PROFESSOR STEWART.

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms. (5)

Politics.

PROFESSOR STEWART.

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's History of the Science of Politics and Sidgwick's Element of Politics. Two terms. (5)

IN LATIN.

Roman Law.

PROFESSOR BLAKE.

(*a*) Roman law before Justinian: based on Bruns's Fontes Juris Romani Antiqui, and Mommsen's Abriss des römischen Staatsrechts. (*b*) Justinian's Institutes, Morey's Outlines of Roman Law, and collateral reading. Two terms. (4)

Roman Philosophy.

PROFESSOR BLAKE.

(*a*) Cicero, De Legibus and De Natura Deorum; History of Roman Philosophy. (*b*) Selected readings from Seneca. Two terms. (3)

Roman Literature.

PROFESSOR BLAKE.

(*a*) History of Roman literature. (*b*) Readings from Latin authors not previously read in course, as far as practicable paralleling the work in (*a*). Two terms. (3)

IN GREEK.

Hellenistic Greek.

PROFESSOR GOODWIN.

Gospel of St. Mark, Acts, and selected Epistles of the New Testament. Thayer's Lexicon. Blass's Grammar of New Testament Greek. Patristic literature. Collateral reading. Selections from Lucian. Two terms. (5)

Dramatic Poetry.

PROFESSOR GOODWIN.

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's Poetics. Collateral reading. Two terms. (5)

Greek Philosophy.

PROFESSOR GOODWIN.

Plato's Republic and other works. Aristotle, selections. Ritter and Preller's Historia Philosophiae Graecae. Zeller's History of Greek Philosophy, and other collateral reading. Two terms. (5)

UNDERGRADUATE COURSES.

PHILOSOPHY.

PROFESSOR STEWARDSON.

1. Psychology. Lectures on the connection of mental with physiological processes. Cerebral localization. The structure and function of sense organs. The phenomena of sensation. No laboratory work. Text-book: William James's Psychology, school edition. First term. (2)

2. Psychology. The phenomena of reason and will. Lectures on association, memory, attention, imagination, apperception, reflection, volition. Text-book: William James's Psychology, school edition. Second term. (2)

3. History of Philosophy. Lectures on Greek philosophy and medieval philosophy with recitations. Text-book: Weber's History of Philosophy (translated by F. Thilly). First term. (2)

4. History of Modern Philosophy, with special attention to Ethics. Readings from Locke, Berkeley, and Hume. Text-book: Weber's History of Philosophy. Second term. (2)

5. Philosophy of Religion. This course consists of from twelve to fourteen lectures and is designed to give the students an oversight of the more important religions of the world, together with an insight into the essential character of religion and the main lines of its development. Second term. (1)

ECONOMICS.

PROFESSOR STEWART.

6. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected treatises. First term. (1)

7. Economics. Practical economic problems; taxation, the railroad problem, the money question, the labor problem, trusts and monopolies, etc. Second term. (1)

8. Economic History. History of the industrial changes in England in the 17th and 18th centuries, and the economic development of England and the United States in the present century. First term. (2)

9. Economics. Development of economic thought, with special reference to the doctrines of the English Classical Economists. Second term. (2)

10. Politics. A study of the organization of the Federal, State, and local government of the United States. First term. (1)

11. Politics. A study of the English, German, and French political organization. Comparison of the nature and scope of the executive, legislative, and judicial organs. Second term. (1)

12. Politics. History of theories of government. Study of the nature and extent of powers of government. First term. (1)

13. Politics. Modern administrative problems. Relation of the State to Industrial Action. Second term. (1)

14. Law. A study of some legal notions with special reference to contracts and industrial relations. Second term. (1)

HISTORY.

PROFESSOR RINGER.

15. European History. Political History of Europe from Congress of Vienna, 1815, to Congress of Berlin, 1878. Second term. (2)

PROFESSOR STEWART.

16. American History. A study of the struggle of Europe for America, the different colonial enterprises, the growth of the English power in North America, and the War for Independence. Second term. (2)

17. American History. The establishment of the Federal Republic, the adoption of the Constitution of 1787, the rise of political parties, the struggle for neutrality, the opening of the West to settlement. First term. (2)

18. American History. The slavery agitation, the industrial development, the Civil War, reconstruction, changing of political lines, rise of new issues, the new territorial expansion. Second term. (2)

19. English History. Introductory sketch of the history of England. Study of the conditions accompanying Colonial Expansion, and the Development of Modern England. Second term. (2)

LANGUAGES.

LATIN.

PROFESSOR BLAKE.

20. Livy. Books I, XXI, and XXII. Latin Prose Composition. First term. (4)

21. Horace. Odes and Epodes. Selections from Catullus. Cicero. De Senectute, De Amicitia. Latin Prose Composition. Second term. (5)

22. Pliny. Selected Letters. Tacitus. Germania and Agricola. Latin Prose Composition. First term. (4)

23. Terence. Andria, Adelphi. Plautus. Captivi or Trinummus. The Octavia. Second term. (3)

24. Horace. Selected Satires and Epistles, Ars Poetica. Vergil. Georgics. Second term. (2)

25. Tacitus. Selections from the Histories and the Annals. Some epistles of Seneca as sight reading. First term. (3)

26. Juvenal. Selected Satires. Martial. Selections. Sight reading from Suetonius. Second term. (3)

27. Lucretius. Book I entire, and selections from the other books. Discussion of ancient materialistic theories. First term. (2)

28. Roman Law. Elementary course. Selections from the Institutes of Gaius. Morey's Outlines of Roman Law. Second term. (2)

GREEK.

PROFESSOR GOODWIN.

29. Xenophon. Oeconomicus or Hellenica. Grammar and Prose Composition. First term. (4)

30. Herodotus. Selections, with sight reading. Grammar and Prose Composition. Second term. (4)

31. Lysias. Selected Orations. Prose Composition. First term. (4)

32. Euripides. Alcestis, Hippolytus, or Bacchae. Prose Composition. Second term. (3)

33. Demosthenes. Olynthiacs and Philippics, or Oration on the Crown; or Thucydides. Selections. Second term. (2)

34. Sophocles. Oedipus Tyrannus or Antigone. First term. (3)

35. Plato. Apology, Crito, and Euthyphro, or Phaedo. Second term. (3)

36. Aristophanes. Clouds, Frogs, or Birds. First term. (2)

37. Aeschylus. Agamemnon; or Pindar. Selected Odes. Second term. (2)

38. Hellenistic Greek. New Testament. Selections from Lucian. To be substituted on occasion for 37. Second term. (2)

FRENCH.

PROFESSOR RINGER, MR. GAUSS, MR. SPENSER.

39. Elementary French. Whitney's French Grammar. Kuhn's French Reader. First term. (2)

40. Elementary French, Continued. Grammar and Reader. Dictation. Reading of short stories from different authors. Second term. (2)

41. French. More advanced work in the Grammar. Reading of Le Cachet Rouge, deVigny; Sans Famille, Malet; La Mare au Diable, George Sand. Dictation. First term. (3) or (2)

42. French. Selections from modern authors and some readings of Molière, Corneille, and Racine. Dictation. Second term. (3) or (2)

(Courses 41 and 42 are for Freshman year of those who entered on French.)

43. French. French Composition. Dictation. Translation from English into French. Reading of some of the most renowned tragedies of Racine and Corneille. First term. (2)

44. French. Lectures on French Literature based on Brunetière's Manuel de l'Histoire de la Littérature Française. Selections from Victor Hugo, Lamartine, deMusset, and the modern historians. Second term. (2)

45. French. Historical Grammar. Darmstetter's History of the French Language. Composition. First term. (2)

46. French. Lectures in French on the literature of the 18th century, with special reference to the Encyclopedists. Composition. Second term. (2)

47. French. Lectures in French on the French Dramatists up to the Romantic School. First term. (2)

48. French. Lectures in French on the Historians of the 19th century and the Dramatists of the Romantic School. Second term. (2)

Courses 46 and 48 will be given in alternate years.

An optional course in French conversation is open to students of all classes. (1)

GERMAN.

PROFESSOR RINGER, MR. GAUSS, MR. SPENSER.

49. ELEMENTARY GERMAN. Joynes-Meissner's Grammar. Joynes's German Reader. First term. (2)

50. ELEMENTARY GERMAN, CONTINUED. Joynes-Meissner's Grammar. Dictation. Reading of short stories from different authors. Second term. (2) or (3)

51. GERMAN. More advanced work in the Grammar. Dictation. Reading of more difficult German prose. First term. (3) or (2)

52. GERMAN. Continuation of course 51. Reading of Freytag's Aus dem Staat Friedrichs des Grossen, and some of the masterpieces of Lessing, Schiller, and Goethe. Second term. (3) or (2)

(Courses 51 and 52 are for Freshman year of those who entered on German.)

53. GERMAN. Jageman's Prose Composition. Dictation. Translation from English into German. Reading of the dramatic masterpieces of Lessing, Schiller, and Goethe, and the poems of Heine. First term. (2)

54. GERMAN. Lectures on German Literature based on Scherer's History of the German Literature. Original compositions. Reading of German Classics. Second term. (2)

55. ADVANCED GERMAN. Advanced Grammar. History of the German Language. Composition. First term. (2)

56. GERMAN. Lectures in German on the Dramatists and Historians of the 19th century. Second term. (2)

57. GERMAN. Lectures in German on Lessing and Herder. Composition. First term. (2)

58. GERMAN. Lectures in German on Schiller and Goethe. Second term. (2)

Courses 57 and 58 will be given in alternate years.

An optional course in German conversation is open to students of all classes. (1)

SPANISH.

MR. GAUSS, MR. SPENSER.

59. (Elective). ELEMENTARY SPANISH. Loiseaux's Spanish Grammar. Reading of easy modern Spanish. Dictation. Drill in Spanish conversation. First term. (2)

60. (Elective). ELEMENTARY SPANISH, CONTINUED. Continuation of course 59. Reading of more difficult Spanish. Writing of short themes and practice in talking Spanish. Second term. (2)

ENGLISH.

PROFESSOR THAYER, MR. EMERY, DR. WHITMAN, MR. COLEMAN.

61. RHETORIC. A composition course based on Genung's Working Principles of Rhetoric, involving recitations and weekly themes on assigned subjects. When the subject of Argumentation is reached in the text-book daily debates take the place of written themes. First term. (2)

62. AMERICAN LITERATURE. Lectures on the basis of Pattee's History of American Literature. Text-book to be read by the student in sections as assigned. The examination is based upon the text-book and the student's note-book. First term. (1)

63. HISTORY OF THE ENGLISH LANGUAGE. Lectures and classroom work, with the use of Lounsbury's History of the English Language as a text-book, supplemented by Emerson's and Champneys's. Second term. (2)

64. DECLAMATION. Practical Instruction in Public Speaking, for all Freshmen. Second term. (1)

65. ENGLISH LITERATURE. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Stopford Brooke's English Literature. First term. (2)

66. LITERARY CRITICISM. The subject varies annually, but is always taken from the Elizabethan Period. For 1903 it will be a critical study of the Elizabethan Literature (non-dramatic), including Milton's Poetry and Prose; supplemented by lectures on the Drama. Second term. (2)

67. ESSAYS, on subjects annually assigned, taken from American authors and requiring the previous reading of some specific work. Six essays a year meet this requirement.

68. ESSAYS, on subjects based on English Literature. Six essays a year meet this requirement.

69. ORATORY. A formal course based upon Baker's Principles of Argumentation and Baker's Specimens of Argumentation, with recitations and the writing of Briefs which are then developed into Forensics. First term. (1)

70. ANGLO-SAXON. Sweet's Anglo-Saxon Primer and Reader, with lectures on early English Literature, and readings from Brooke and Earle. First term. (3)

71. ENGLISH PHILOLOGY. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the

residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue previous to the Age of Chaucer. Preparation required: 70. Second term. (3)

72. Middle English. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, The Student's Chaucer (Clarendon Press), Skeat's edition of The Vision of Piers the Plowman, Wiclif's translation of the New Testament revised by Purvey, and Gower's Confessio Amantis are assigned. First term. (3)

73. Poetics. A course based on Gummere's Handbook of Poetics, Corson's Primer of English Verse and the use of Palgrave's Golden Treasury, Schelling's Elizabethan Lyrics, and Pancoast's Standard English Poems, with practical exercises in verse-composition. Second term. (3)

74. To Seniors who wish to carry their linguistic work a little further, into the field of Teutonic philology, a course, alternative with 73, is offered, based upon Wright's Gothic Primer and Sweet's Icelandic Primer. Preparation required: 70 and 71. Second term. (3)

75. Optional courses on the Rise and Development of the English Novel and on the English Poets of the 19th century are offered in alternate years. These are both lecture courses, with private reading assigned; and, if supplemented by a rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

MATHEMATICS AND ASTRONOMY.

PROFESSOR THORNBURG, ASSISTANT PROFESSOR MEAKER, ASSISTANT PROFESSOR LAMBERT, MR. OGBURN.

76. Advanced Algebra, beginning with theory of quadratic equations and completing the subject. First term. (3)

77. Trigonometry. Spherical Trigonometry, including mensuration and use of logarithmic tables. Preparation required: 76 and 78. First term. (1)

78. Solid Geometry, beginning with Book VII and completing the subject. Preparation required: 76. First term. (1)

79. Trigonometry. Plane and Spherical Trigonometry, including mensuration and use of logarithmic tables. Preparation required: 78. Second term. (3)

80. Elementary Mechanics. Statics and dynamics with solutions of numerous illustrative and practical problems. Preparation required: 77. Second term. (5)

81. Analytic Geometry. Graphic representation of loci on cross-section paper, plane and solid analytic geometry. Preparation required: 79 or 80. First term. (5)

82. Differential and Integral Calculus. Embracing applications to analytical geometry problems, theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 81. Second term. (5)

83. Analytical Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 82. First term. (2)

84. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. Preparation required: 82 or 81 and 187. First term. (3)

85. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 82 and 84. Second term. (2)

FREEHAND DRAWING.

MR. GELHAAR.

86. Freehand Drawing, with especial reference to architecture, construction and machine parts. First term. (2)

CIVIL ENGINEERING.

PROFESSOR MERRIMAN,

MR. DUFOUR, MR. SCHNEIDER, MR. ROGERS, MR. FRANCO.

87. Projection Drawing. The use of instruments. Tracing and lettering. The descriptive geometry of projections, intersections, and developments. Isometric drawing. Plans, elevations, and sections of simple structural details from actual measurements. Preparation required: 78, 86. Second term. (3)

88. Structural Drawing. Plans, elevations, and sections are made from actual measurements of structures. Problems in stone cutting, including drawings for buttresses, piers, culverts, and arches. The use of water colors. Preparation required: 86, 87. First term. (2)

89. Land Surveying. The theory and computation of areas, dividing land, and determining heights and distances. Preparation required: 77. Second term. (1)

90. Land Surveying. Field work with the level and transit in the determination of heights and distances, and in making surveys of farms. Exercises in map drawing and in the plotting of field notes. Preparation required: 87, 89. First term. (2); also in Summer term, four weeks, beginning June 19, 1902. If taken in the Summer term a fee of $15 is required.

91. Topographic Surveying. The theory and use of the plane table, and of the transit and stadia. Pen topography. Detailed field work in rough country, and the construction of topographic contour maps. Leveling and triangulation. The adjustment of instruments with the investigation of their systematic errors. Preparation required: 90. Summer term. Four weeks, beginning June 19, 1902.

92. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork. Preparation required: 91. Second term. (4)

93. Geodetic Surveying. Elements of the method of least squares and its application to the adjustment of triangulations. The figure of the earth. Field work in triangulation and in the determination of azimuth. Preparation required: 82, 84, 91. First term. (3)

94. Construction. Lectures on timber, stone, mortar, and concrete and on their use in structures. Visits of inspection with written reports on structures. The construction of roads, streets, and pavements with the methods for their drainage and repair. Lectures on the history of engineering. Preparation required: 86, 87. First term. (2)

95. Construction. Lectures on foundations with piles, cribs, coffer dams, and caissons. Visits of inspection, with written reports. Lectures on river and harbor improvements, on tunnels and canals, and on engineering work in progress of construction. Technical readings in German or French. Preparation required: 80, 94. Second term. (3)

96. Construction. The theory and design of masonry walls, dams, and arches by both graphic and analytic methods. Lectures on cements and mortars, each student making all the standard tests in the laboratory. Visits to cement manufactories and to engineering works, with written reports thereon. Preparation required: 80, 82, 95. First term. (3)

97. Railroads. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Preparation required: 96. Second term. (2)

98. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Each student performs twelve experiments in the testing laboratory, which is equipped with 20,000, 100,000 and 150,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion, a 2,000-pound cement machine, and other apparatus for special work. Preparation required: 80, 82. First term. (4)

(A fee of $1.00 is required for this course.)

99. Materials. The materials of construction with reference to inspection and testings. Applications for the theory of elasticity to the determination of true internal stresses. The sources of error in testing, and the rules proposed for their elimination. Preparation required: 98. First term. (2)

100. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. Preparation required: 80, 87. First term. (2)

101. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to simple cases. Analysis of stresses in bridge trusses under dead loads. Preparation required: 80, 88. Second term. (3)

102. Bridge Design. Sketches and measurements of bridges in the vicinity, with working drawings of the details. Proportioning of rods, eye bars, posts, and joints. Preparation required: 88, 101. First term. (4)

103. Roofs and Bridges. The theory and computation of stress in roof and bridge trusses under dead, live, and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 101, 102. Second term. (4)

104. Bridge Design. The design of bridge floors and trusses. Sketches of details of bridges in the vicinity. Computations and working drawings are made from specifications for a railroad bridge of short span, and estimates of its weight are prepared. Preparation required: 98, 103. First term. (4)

105. Bridges. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. Methods of analysis for statically indeterminate structures. Arches of iron and concrete. Preparation required: 98, 104. Second term. (3)

106. Architecture. Architectural styles and the history of architecture. Freehand drawing of columns, doorways, and other details. Simple original designs. Preparation required: 86, 88. First term. (2)

107. Perspective. Shades, shadows, and linear perspective. The construction of perspective views of buildings from plans and elevations. Preparation required: 106. Second term. (3)

108. Architectural Design. The design of brick and stone houses, including the preparation of plans and specifications. Preparation required: 98, 106. First term. (2)

109. Architectural Design. The design of steel trusses and three-hinged arches for trainsheds. The design of tall steel buildings. Preparation of plans and specifications. Building superintendence. Preparation required: 108. Second term. (5)

110. Heating and Ventilation. Methods of heating buildings with hot air, hot water, and steam. Methods of ventilation by flues and by forced blast. Details of boilers, piping, radiators, and ventilating appurtenances. Preparation required: 80, 82. First term. (2)

111. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. Preparation required: 80, 82. Second term. (3)

112. Sanitary Engineering. Systems of water supply, including purification systems, reservoirs, pipe lines, and pumping plants. House drainage. Systems of sewerage, with methods of purifying sewage. Visits of inspection. The investigation and design of tanks, pipe lines, and sewers. Preparation required: 96, 111. First term. (4)

113. Thesis for Degree of C.E. Candidates for the degree of Civil Engineer select the subjects of their theses in the first term of the Senior year. Advice is given in regard to the plan of work, and references to literature are indicated. Reports concerning the progress of the investigation are made at intervals during the second term. The thesis is regarded as a part of the final examinations of the course.

SUMMER SCHOOLS IN CIVIL ENGINEERING.

Surveying. Courses in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the Summer vacation. In 1902 these courses begin at 8.30 A. M. on June 19 and close on July 12.

The work in Land Surveying is described under No. 90, on page 43. Students in Mining Engineering are required to take this work at the close of the Freshman year. The fee for other persons is $15.

The work in Topographic Surveying is described under No. 91, on page 43. Students in Civil and Mining Engineering are required to take this course at the close of the Sophomore year. The fee for other persons is $15.

Strength of Materials. Twenty-four exercises in the classroom and six in the testing laboratory will be given in 1902, beginning at 9.30 A. M. on August 25 and ending on September 20. As this work is a rapid review of the subject, it can be taken only by those who study during July and August under instructions which must be obtained from the Professor of Civil Engineering prior to June 29, 1902.

MECHANICAL ENGINEERING.

PROFESSOR KLEIN,
MR. HECK, MR. TROWBRIDGE, MR. LEUTWILER.

114. Drawing and Elements of Machine Design. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. Second term. (3)

115. Constructive Elements of Machinery and of Electrical Apparatus. Visits of inspection. Examination and sketching of machine parts and of electrical apparatus and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with freehand sketches containing the leading dimensions. The class is divided into sections, which are separately taken into the shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken apart and again put together by this class. For further details see special circulars of the M.E. and E.E. departments. Summer term. Four weeks, beginning June 19, 1902.

116. Elements of Machine Design. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating, and sliding pieces, belt and toothed gearing, levers, and connecting rods. First term. (3)

117. Boilers. Description of various types, and of details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Peabody and Miller. First term. (1)

118. Steam Engine. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc. Valve gears, valve diagrams applied to slide valves, shaft governors and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Holmes' Steam Engine. Second term. (4)

119. Steam Engine. Shorter course. Second term. (3)

120. Mechanical Technology. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings, and finished pieces, which are under construction in the shops at the time and drawings for which have been given to him on entering the shops. The student's work is directed not only by these but also personally by an instructor, who accompanies him in each shop, gives necessary explanations, and tests the extent and accuracy of his knowledge. Four teachers are engaged in this work, one for each shop and section. Summer Term. Four weeks, beginning June 19, 1902.

121. Mechanics of Machinery. Graphical statics of mechanisms. Determination of the efficiency of a machine and of the forces acting in every one of its pieces and parts. All the problems are given to the students in the form of black prints and consist of a series of suitably graded examples of machinery. In these both frictional and inertia resistances are considered. First term. (2)

122. Engineering Laboratory. Calibration and application of mechanical engineering measuring instruments. First term. (1)

123. Graphic Dynamics of a High Speed Engine. Complete force analysis, first by approximate practical methods and then by methods theoretically exact; action of steam forces, inertia resistances, etc. Preliminary design, consisting of a determination of the most important dimensions for an engine which is to work under given conditions. Second term. (3)

124. Engineering Laboratory. Work of 122 continued; experiments on the flow of fluids and determination of the mechanical efficiencies of transmitting gear and of special machines with absorption and transmission dynamometers; testing of steam appliances. Second term. (1)

125. Mechanics of Machinery. Machinery of Transmission. Weisbach-Herrmann series: Vol. III, Part 1, Section 1. This treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The Introduction is also studied for its excellent analytical presentation of the subject of acceleration. Second term. (3)

126. Summer School in Engineering Laboratory. Testing of air compressor, of a turbine, of water and electric motors, of

hot-air and gas engines, of steam generators, and of simple and multiple-cylinder engines. Summer term of four weeks beginning June 19, 1902.

127. Summer School in Marine Engineering. Constructive elements of ships. Visits of inspection and observation to the ships, shops, and yards of ship building establishments. Four weeks, beginning June 19, 1902.

128. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases and vapors. Application of the results and of graphical methods to technical problems. First term. (3)

129. Kinematics of Machinery. This treats of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. As here pursued it consists of a few lectures accompanied by a large amount of work in the drafting room. This work is mainly expended on the construction of centrodes, of inversions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including many forms of inertia resistances and external forces. First term. (5)

130. Design of Special Machinery. Each student is required to design some example of metal working machinery, as a lathe, plane, drill, or milling machine, so as to gain experience in proportioning parts both for strength and stiffness. This design is followed by one for a still more special machine, say, for performing some unusual operation. First term. (4)

131. Design of Special Machinery. Shorter course. First term. (2)

132. Engineering Laboratory. Work of 126 continued. Indicator practice: taking of diagrams from the engines in the shops and power plants of the neighborhood—selected so as to represent as many types as possible—and working up of the results. To this is added some dynamometer work and one boiler test. First term. (1)

133. Mechanics of Machinery. Cranes, Excavators and Pile Drivers. Chapters VI to VIII, inclusive, of Weisbach-Herrmann's Mechanics of Hoisting Machinery. These recitations are

supplemented by visits of inspection. THE LOCOMOTIVE. The descriptive portion of the work is illustrated by drawings from good current practice and includes visits to the L. V. R. R. Repair Shops at South Easton. The mechanics of the locomotive is taken up as fully as time will permit; the subjects touched on are: General proportions, detailed analysis of the forces and inertia resistances, valve gear action, performance of the running gear on curves, etc. Extensive use is made of diagrams showing the fluctuations of the various periodic forces throughout a revolution. First term. (2)

134. MARINE ENGINEERING. Description of the various types of tubular and tubulous boilers, details, management, proportions, study of natural and forced draught and circulation; determination of radius of action of steamships. Text-book: Bertin and Robertson's Marine Boilers. First term. (1)

135. MARINE ENGINEERING. Ship Drawing. This work consists in laying down and fairing the lines of a vessel that has already been designed; then are made such general drawings as mid-ship section, out-board profile, in-board profile, and upper deck plans. First term. (2)

136. MARINE ENGINEERING. Ship calculations. Calculations relating to the forms, dimensions, and strength of ships, to their weight and centers of gravity, and to the steering gear. Text-book. Thearle's Theoretical Naval Architecture. Second term. (2)

137. DESIGN OF SPECIAL MACHINERY. This work is mainly a continuation of course 130. To complete this course there is required an original design for a hoist, or hydraulic press, or an automatic machine used for manufacturing some such article as wire nails. Second term. (5)

138. DESIGN OF SPECIAL MACHINERY. An abridgment of course 137. Second term. (2)

139. ENGINEERING LABORATORY. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term. (1)

140. MECHANICS OF MACHINERY. Hoists, Pumps, Compressors, Blowing Engines, and Fans. The presentation is that of the Weisbach-Herrmann series. The class-room work is supplemented by suitably timed visits of inspection. Second term. (4)

141. MARINE ENGINEERING. Marine Engines. Seaton, Busley, and Sennet and Oram used as reference books. Advanced study of the Multiple-cylinder Engine; discussion of the strength and proportion of the moving parts; determination of the best expan-

sion ratios, and the positions of the cylinders; valve-gears suited to marine types; equalization of the work on the several cranks and balancing of the moving parts. Second term. (2)

142. Marine Engineering. Ship resistance and propulsion. Estimate of the eddy, skin and wave resistances of a ship; the design of the propeller and the calculation of the power required to drive the ship. Text-book: Durand. First term. (1)

143. Marine Engineering. Ship Drawing. The methods of fastening together the different parts of a ship are first taken up and then drawings are made to show the general arrangement of the machinery and the disposition of the cargo. The course is completed by making the preliminary design or Sheer Draught for a new ship. Second term. (2)

144. Thesis for Degree of M.E. Candidates for the degree of Mechanical Engineer are required to present theses upon topics connected with mechanical engineering. Drawings and diagrams are required whenever the subjects discussed need such illustration.

For Summer Schools see courses 115 and 120, also statement on page 65.

METALLURGY AND MINERALOGY.

PROFESSOR FRAZIER, ASSISTANT PROFESSOR RICHARDS, MR. MILLER.

145. Crystallography. Elementary course in Geometric Crystallography, with practical exercises in the determination of crystalline forms in models and actual crystals. First term. (2)

146. Mineralogy. Elementary course in physical, chemical, and descriptive Mineralogy, with practical exercises in the determination of about two hundred of the more common mineral species. Text-book: E. S. Dana's Text-book of Mineralogy. Second term. (3)

(A deposit of $5 is required from each student taking courses 145 and 146 to cover damage to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it will not exceed $2 for each student.)

147. Blowpipe Analysis. An elementary course in blowpipe analysis considered as a method of chemical qualitative analysis.

Illustrated lectures followed by practical testing for thirty-five bases and fifteen acids. Reference book: Elementary Blowpipe Analysis by Landauer. Second term. (1)

148. Blowpipe Analysis. Advanced blowpipe tests and separations. The application of blowpipe methods as primary tests for determining minerals. Text-book: Plattner's "Löthrohrprobirkunde." Sixth German edition, revised by Dr. F. Kolbeck. First term. (1)

149. Blowpipe Analysis. An optional course in quantitative blowpipe analysis, dealing particularly with the determination of gold, silver, cobalt, nickel, copper, lead, tin, bismuth, mercury, and analysis of coal. Reference book: Plattner's "Löthrohrprobirkunde." First term. (1)

(In each of the Blowpipe courses a deposit of $2 is required, of which, on an average, $1 is retained to cover cost of gas, chemicals, and specimens supplied.)

150. Drawing. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. Flat tinting with water colors. First term. (3) Second term. (1)

151. Metallurgical Construction. Examination and sketching of metallurgical plant in the vicinity. General views and working drawings of the plant examined, accompanied by written descriptions of its construction and operation. Second term. (3) For students in the courses in Metallurgy: First term. (1) Second term. (2)

152. Metallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of metallurgical plant under given conditions. Second term. (2)

153. General Metallurgy and the Metallurgy of Iron. General Metallurgy: Metallurgical processes. Transmission of heat. Measurement of high temperatures. Furnaces. Fluxing. Fireproof materials. Principles of thermal chemistry. Combustion. Properties of natural and artificial fuels. Manufacture of gaseous fuels. The Siemens Furnace. Charcoal burning. Coking. The electric furnace.

Metallurgy of Iron: Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. Remelting in the foundry. Pig washing. Puddling. The Bessemer process. The open hearth process. Cementation. Manufacture of crucible steel. Direct processes. Methods of casting and forging. Second term. (5)

154. General Metallurgy and the Metallurgy of Iron. Shorter course. Second term. (3)

155. Metallurgy of Copper, Lead, Silver, Gold, Zinc, Mercury, and Aluminium: Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet processes. Electrolytic processes. Lead: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. Silver: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. Gold: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. Zinc: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. Mercury: Chemical and physical properties. Ores. Processes of extraction. Aluminium: Chemical and physical properties. Ores. Extraction in the electric furnace. First term. (4)

155A. Metallurgical Laboratory. Calibration and use of pyrometers and calorimeters. Determination of melting and freezing points of metals and other metallurgical products. Study of cooling curves. Deposit, $10. Second term. (1)

156. Theory of Electrolysis. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference book: Jones's Theories of Electrolytic Dissociation. First term. (1)

157. Electrometallurgy. Lectures discussing the practical applications of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's Electrometallurgie, Blount's Practical Electrochemistry. Second term. (1)

157A. Electrometallurgical Laboratory. Quantitative separations and depositions of metals by electrolysis. Experimental determination of the conditions controlling the nature of electrolytic deposits. Electrolysis of salts. Deposit, $10. First term. (1)

158. Thesis for the Degree of Met. E. Every student in Metallurgical Engineering is required to present a thesis on some topic connected with this subject.

159. Thesis for the Degree of El. Met. The thesis required for this degree will be upon some subject connected with the theory or practice of Electrometallurgy.

For Summer Schools see courses 115 and 120, also statement on page 65.

GEOLOGY AND THE NATURAL SCIENCES.

PROFESSOR WILLIAMS,

ASSISTANT PROFESSOR BARRELL, MR. ECKFELDT, DR. HALL.

160. Megascopic Lithology. Determination of rocks which can safely be distinguished with the pocket lens, supplemented by ordinary chemical and blowpipe tests. Lectures and recitations followed by laboratory work on hand specimens. Preparation required: 146. First term. (3)

161. Megascopic Lithology. Shorter course, embracing only the most common rocks. Lectures, recitations, and laboratory work. Preparation required: 146. First term. (2)

162. Petrology. The optical properties of minerals and their study with the petrological microscope. Recitations and laboratory work. Preparation required: 146. Second term. (2)

163. Petrology. The determination of rocks, their chemical and mineralogical composition and classification, their origin. Recitations and laboratory work with the microscope combined with a study of hand specimens. Preparation required: 162. First term. (2)

(A deposit of $5 is required from each student taking courses 162 and 163 to cover wear and tear, which with care need not exceed $2.)

164. Petrology. Advanced work in petrology consisting of the detailed study of some few phases of the subject. Second term. (2)

165. Geology. A brief course in structural, dynamic, and historic geology for those who desire to pursue the subject as a culture study. Recitations and lectures illustrated by suites of fossils and optional work in the field. Preparation required: 146. Second term. (3)

166. Geology. Physiographic, structural, and dynamic geology. A broader course adapted to the needs of those who will use geology professionally. Lectures, recitations, assigned reading with trips in the field. Preparation required: 146. First term. (2)

167. Geology. A continuation of 166. Historical geology. Recitations and lectures illustrated with typical fossils. Preparation required: 176, 166. Second term. (2)

168. Geology. Invertebrate paleontology. Text-book and laboratory work in describing and identifying fossils. Preparation required: 167. First term. (4)

169. Economic Geology. Theories of the formation of deposits, their structure, geological horizons, and geographic distribution. Recitations and lectures illustrated by specimens of ores. Preparation required: 165 or 166. First term. (2)

170. Physiography. The classification of land forms; their stages of development; the factors determining them; the geographical distribution. Lectures, assigned reading, and field work. Preparation required: 165 or 166. First term. (3) to (5)

171. Field Geology. Elementary field geology to accompany 163. Preparation required: 146, 176. First term. (3)

172. Field Geology. Field work to accompany the advanced petrology and historical geology. Second term. (3)

173. Geological Surveying. The identification of rocks and tracing of boundary planes under capping. The study of soils. Solution of problems in mapping. Forms of field notes. Recitations and lectures, field work, map drawing. Preparation required: 165 or 166. Second term. (2)

174. Pennsylvania Geology. This course is advanced work consisting in the study of certain problems well illustrated in this State, combining the reading of the literature with laboratory and field work. Preparation required: all of the previous geology. Second term. (3) or (5)

175. Botany. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and references to text-books. Preparation advantageous: 176. Second term. (2)

176. Zoölogy. The structure, development, relationships, habits, and geographical distributions of animals. Lectures, recitations, and laboratory work. First term. (3)

177. Biology. Lectures on the embryology and anatomy of vertebrates with discussions of the more important biological theories; variation, heredity, evolution, etc. In the laboratory, examples of the chief classes of vertebrates will be dissected with a view to following the evolution of organs. Preparation required: 176. Second term (3)

177a. Histology. Lectures, reading and laboratory work on the structure, growth, and differentiation of tissues. Preparation required: 177. First term. (2)

178. Thesis for the Degree of B.S. (Geol.). Every student in this course who is a candidate for this degree is required to present a thesis on some topic connected with Geology.

For Summer Schools see courses 90 and 91, also statement on page 65.

DR. ESTES.

179. Hygiene. Lectures on Physiology and Health. First term. (1)

MINING ENGINEERING.

PROFESSOR WILLIAMS, MR. MILLER, MR. ECKFELDT.

180. Mining Engineering. Prospecting, valuation of property, boring, location of plant, timbering, shaft sinking. Lectures, references to text-books, monographs, and periodicals. Visits to mines. Preparation required: 165 or 166. Second term. (3)

181. Mining. Blasting, development of deposits, systems of winning underground and at daylight. Lectures, etc. Second term. (2)

182. Mining Engineering. Haulage by track and wire, hoisting, drainage, ventilation, and lighting. Accidents, their cause, means of prevention, rescue, etc., police of mines, hygiene, rules, and laws. Lectures, etc. First term. (3)

183. Mining Engineering. Theory of ore dressing. Physical principles on which it depends. Machines used in wet, dry, and magnetic methods, with the order in which they are arranged. The location of dressing works. The preparation of anthracite. Lectures, etc., and visits to dressing works. Second term. (3)

184. Mine Surveying. Location of stations underground. Temporary and permanent side notes. Connecting surface and underground work through shafts or slopes. Mapping by coördinates. Care of maps, and variations due to temperature and moisture. Permanent forms of records. Detection of errors. Rectification of bore holes. Lectures, etc., followed by practice with a mine corps and construction of map from notes of actual survey. Preparation required: 89, 90. Second term. (2) In the Summer of 1903 and thereafter this will be taught in a Summer School.

185. Mechanical Drawing. Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of drawings by isometric sketches. General views from given details. Sections of simple construction. Intersections of spheres, cones, cylinders, etc., accompanying the study of descriptive geometry and illustrated from examples of mining and metallurgical plant. Flat tinting with water colors. First term. (3)

185a. Mining Design. The design of mining plant to meet assigned conditions, with detailed working drawings and estimates of cost. Each problem is accompanied by a memoir containing all calculations and descriptions, with which are bound tracings or blue prints of all drawings. Preparation required: 180, 182. First term. (2)

186. Thesis for the Degree of E.M. Candidates are required to present a thesis on some topic connected with this subject.

For Summer Schools see courses 90 and 91, also statement on page 65 and above after course 184.

PHYSICS AND ELECTRICAL ENGINEERING.

Physics.

PROFESSOR FRANKLIN,
MR. MACNUTT, DR. SCHENCK, MR. FREUDENBERGER.

187. Elementary Physics. Mechanics and Heat. Lectures, recitations and problem work. Preparation required: 76 and 77. Second term. (2)

188. Elementary Physical Laboratory, accompanying 187. Fee $4. Second term. (1)

189. Elementary Physics. Electricity and Magnetism. Lectures, recitations, and problem work. Preparation required: 187, 188. First term. (3)

190. Elementary Physics. Mechanics, Heat, Electricity, and Magnetism. Lectures, recitations, and problem work. This study is offered to students in the School of General Literature. Preparation required: 76 and 77, or 78. First term. (3)

191. Elementary Physical Laboratory, accompanying 189 and 190. Fee $4. First term. (1)

192. Elementary Physics. Light and Sound. Lectures, recitations, and problem work. Preparation required: 189 or 190 and 191. Second term. (3)

193. Elementary Physical Laboratory, accompanying 192. Fee $4. Second term. (1)

194. Advanced Theory of Electricity and Magnetism. Electrical units, electrical measurements, inductance, the magnetism of iron, and electromagnetic theory. Lectures, recitations, and problem work. Preparation required: 82 and 188 to 193, inclusive. First term. (2)

195. Electrical Laboratory. Precise electrical measurements. In connection with this study a number of simple dynamo and motor tests are given in order to facilitate the class work in 204 and 205. Fee $4, deposit $6. First term. (1)

196. Electrical Laboratory. Precise electrical measurements. In connection with this study a number of simple dynamo and motor tests and a few alternating current measurements are given in order to facilitate the class work in 204 and 206. Fee $4. Deposit $6. Second term. (1) For students in the Course in Physics: First term. (1)

197. History of Physics. This study is based upon Poggendorff's "History of Physics" (in German), supplemented by encyclopedia articles. Second term. (4)

198. Theory of Light. This study is based upon Preston's "Theory of Light." First term. (5)

199. Theory of Heat. This study is based upon Clausius's "Theory of Heat," supplemented by the reading of monographs on Physical Chemistry. Second term. (4)

200. Physical Laboratory. This course in laboratory work, offered during the Senior year to students taking the Course in Physics, consists of refined measurements in any branch of Physics at the option of the student, and it leads to the thesis work of the following term. First term. (2)

201. Physical Seminary. The study of current literature in Physics. The membership of the Physical Seminary includes the corps of instructors of the department of Physics and Electrical Engineering, together with Senior students in Physics. First and second terms. (2)

202. Thesis for the Degree of B.S. (in Physics). Each candidate for the degree of B. S. (in Physics) is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory or experimental research.

Electrical Engineering.

PROFESSOR FRANKLIN, ASSISTANT PROFESSOR ESTY, MR. REGESTEIN, MR. FREUDENBERGER.

203. Constructive Elements of Electrical Apparatus. Inspection and sketching of armatures, field magnets, commutators, base frames, bearings, brushes, brush holders, and rocker arms of dynamos and motors; of switch boards and switch board appliances; of lamp mechanisms, starting rheostats, regulators, cut-outs, meters, and line material; of telephone and telegraph material. Summer term. Four weeks, beginning June 19, 1902.

204. Dynamos and Motors. Elementary electrodynamics with applications to direct current machinery. Principles of construction, operation, and characteristics of dynamo electric machinery with special reference to direct current types. Illustrative problems. Preparation required: 187 to 193, inclusive. First term. (2)

205. Dynamos and Motors. This course is similar to the preceding, but is especially adapted to those students who do not continue this subject in the Senior year. Special attention is given to the operation, regulation, management, and methods of testing of dynamos and motors. Illustrative problems. Preparation required: 187 to 193, inclusive. First term (2)

206. Theory of Alternating Currents. A general survey of the elementary theory of alternating currents. Lectures, recitations, and problem work. Preparation required: 194, 195, 204, (or 205). Second term (2)

207. Electrical Engineering. Continuation of 204. General survey of the more important industrial applications of electricity for lighting and power purposes. Systems of generation, distribution, and transmission by direct and alternating currents; wiring; arc and incandescent lamps; feeder regulation. The latter part of the course is devoted to alternating current generators, motors, and transformers, being supplementary to the course in the Theory of Alternating Currents. Preparation required: 194, 204. Second term. (2)

208. Electrical Engineering. Similar in general scope to the preceding. Particularly adapted to students who do not further specialize in the various technical applications above outlined. Preparation required: 194, 205. Second term. (2)

209. Theory of Alternating Currents. Continuation of 206. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 206, 207. First term. (2)

210. Dynamo-Electric Machinery. Continuation of 204. Advanced study of dynamo and motor characteristics, theory of regulation, armature windings, armature reactions, methods of testing dynamo-electric machinery, transformers and transformer testing. Preparation required: 206, 207. First term. (2)

211. Electrical Design. Calculations of electromagnetic mechanisms and direct current dynamo-electric machinery; a graded series of problems leading up to original designing; drafting. Preparation required: 206, 207. First term. (2)

212. Electric Lighting and Central Stations. Systems of electric lighting; principles and economics of location of site; selection, arrangement, and subdivision of generating units; general design of buildings and interior arrangements. Methods and economics of distribution of electrical energy for light and power by direct and alternating currents; regulation and operation of supply circuits. Manufacture, care, and use of arc and incandescent lamps; insurance rules and regulations; commercial photometry; visits of inspection to neighboring plants. Preparation required: 206, 207. First term. (2)

213. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; reports on thesis work;

new inventions and discoveries critically reviewed. Indexing of periodical literature. Preparation required: 206, 207. First term. (1)

214. Telegraphs and Telephones. Quadruplex telegraphy; synchronous multiplex telegraphy; printing telegraph; submarine telegraphy; wireless telegraphy; telephone systems and appliances. Preparation required: 194, 195. First term. (2)

215. Dynamo Laboratory. Direct current. Experimental studies and tests of direct current dynamos, motors, and appliances. Preparation required: 196, 204. Fee, $6. First term. (2)

216. Electrotechnology. This course begins with a review of principles of electric and magnetic theory with reference to their application in the practical work of the Metallurgical Engineer. Then follows a brief study of the dynamo and motor, of switch board apparatus, of wiring systems, and of safety devices. A portion of the time is devoted to electrical measurements and to simple experimental studies of the dynamo and motor. Preparation required: 189, 191. Fee $3. First term.(2)

217. Electrical Laboratory accompanying 156. Experimental studies in electrolysis. Measurements of resistances of electrolytes, applications of Faraday's laws of electrolysis, studies of electrolytic polarization, determinations of critical voltages of decomposition, tests of primary batteries and storage batteries, and tests of commercial types of electrolytic cells. Fee, $4. First term. (1)

218. Theory of Alternating Currents. Continuation of 209. Advanced theoretical studies of transformers, induction motors, and transmission lines. Preparation required: 209, 210, 211, 212, 215. Second term. (2)

219. Electrical Design. Calculations of alternating current apparatus, including generators, motors, transformers, and rotary converters and leading up to original designing; drafting. Preparation required: 209, 210, 211. Second term. (2)

220. Electric Power Transmission and Traction. The long distance transmission of power by electricity for use in lighting, traction, mining, and manufacturing work. Design, construction, maintenance and protection of lines. Receiving systems. Principles of construction of, electrical distribution for, and testing of, electric traction systems. Applications to surface and elevated electric roads and to mine haulage. Testing of light and power plants; visits of inspection to neighboring plants. Preparation required: 209, 210, 212. Second term. (2)

221. Electrical Engineering Seminary. Continuation of 213. Preparation required: 210, 211, 209, 213. Second term. (1)

222. Dynamo Laboratory. Alternating current. Experimental studies and tests of alternating current dynamos, synchronous motors, induction motors, rotary converters, transformers, and appliances. Preparation required: 209, 215. Fee, $7. Second term. (3)

223. Dynamo Laboratory. A brief course covering the simpler parts of 215 and 222. Preparation required: 194, 195, 196, 204. Second term. (2)

224. Dynamo Laboratory. Alternating current. Experimental studies and tests of alternating current dynamos, synchronous motors, induction motors, rotary converters, transformers, and appliances. Briefer course. Preparation required: 209, 215. Fee, $6. Second term. (2)

225. Electric Traction. This course begins with a review of the principles of electric and magnetic theory with reference to their application to the generation, transmission, and utilization of electrical energy. Then follows a study of the principles and economics of power plant installation and line construction; rolling stock and its electrical equipment; management and testing of electric traction systems. This course is especially adapted to the needs of Civil Engineers. Preparation required: 189, 191. Second term. (2)

226. Thesis for the Degree of E. E. Each candidate for the degree of Electrical Engineer is required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. The work upon which the thesis is based is done during the second term, and it consists in part of reading from references furnished by the professor in charge, and in part of independent work in theory, experimental research, or designing.

CHEMISTRY.

PROFESSOR CHANDLER,

MR. SPANUTIUS, DR. SCHOBER, DR. ULLMANN, MR. BUCH.

227. General Introduction to Theoretical Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, lantern pictures, and specimens from the

museum. Note-books on the lectures required. Reference book: Remsen's Inorganic Chemistry, Advanced Course. First term. (2)

228. Chemical Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. First term. (2)

229. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures. Text-book: Prescott and Johnson's Qualitative Chemical Analysis. Second term. (6)

230. Qualitative Analysis. Shorter courses. Second term. (5), (3), or (2)

231. Stoichiometry. Chemical problems, and reactions. Text-book: Thorpe and Tait's Chemical Calculations. Second term. (2)

232. Chemical Philosophy. Theories of Chemistry; physical and chemical methods of determining atomic and molecular weights, solutions, electrolysis, thermo-chemistry, etc. Text-books: Tilden's Chemical Philosophy; Whitley's Chemical Calculations; Remsen's Inorganic Chemistry, Advanced Course. First term. (3)

233. Quantitative Analysis. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds. Text-book: Fresenius's Quantitative Analysis, edited by Allen and Johnson. First term. (6)

234. Quantitative Analysis. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores, and metallurgical products. First term. (3)

235. Quantitative Analysis Conference. Discussions concerning the laboratory work of course 233. First term. (1)

236. Quantitative Analysis. Continuation of course 234. Second term. (4)

237. Quantitative Analysis. Continuation of course 233. Analysis of minerals, ores, slags, alloys, etc. Text-books: Fresenius's Quantitative Analysis, Blair's Chemical Analysis of Iron. Second term. (6)

238. Quantitative Analysis. Shorter course. Second term. (2)

239. Quantitative Analysis Conference. Discussions concerning laboratory work of course 237. Second term. (1)

240. Theoretical Chemistry. The elements and their compounds. Text-book: Remsen's Chemistry, Advanced Course. Second term. (3)

241. Toxicology. Lectures illustrated by experiments and by a large collection of specimens of poisons from the museum of chemistry, and supplemented by a short course of laboratory work on some of the common poisons. First term. (2)

242. Quantitative Analysis. Continuation of course 237. Ores and alloys; complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Fresenius's Quantitative Analysis, Allen and Johnson, Hempel's Gas Analysis. First term. (5)

243. Quantitative Analysis. Shorter Course. First term. (3) or (2)

244. Quantitative Analysis Conference. Discussions concerning the laboratory work of course 242. First term. (1)

245. Quantitative Analysis. Continuation of course 236. Analysis of ores and metallurgical products, and gas analysis. First term. (2)

246. Organic Chemistry. Illustrated lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of converting compounds of one class into those of another. Text-books: Remsen's Introduction to the Study of the Carbon Compounds; Richter's Organic Chemistry, translated by Smith. First term. (5)

247. Organic Chemistry. Practical laboratory work. Determination of specific gravities, melting points, boiling points, vapor densities; also of chlorine, bromine, iodine, and sulphur of organic substances. Combustion analysis, nitrogen determination, fractional distillation, and the preparation of fifty pure organic compounds. Text-books: Gattermann's Practical Methods of Organic Chemistry, translated by Schober; Levy's Organischer Präparate. Second term. (6)

248. Organic Chemistry Conference. Discussions concerning the laboratory work of course 247. Second term. (1)

249. Industrial Chemistry. Preparation of a number of chemically pure inorganic salts from minerals, commercial products, etc.; of various dyes and dye mixtures, and the dyeing of cotton, silk, and woolen fabrics; calico printing; manufacture of coal gas; fermentation; bleaching. First term. (3)

250. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, antimony, gold, silver, and iron; also gold and silver bullion analysis by processes practiced in the United States Mint. Text-book: Rickett's and Miller's Notes on Assaying. First term. (3)

251. Microscopy. Instruction in the use of the microscope. Text-book: Bausch's Manipulation of the Microscope. First term. (2)

252. Industrial Chemistry. Lectures on the chemical industries, illustrated by experiments, diagrams, lantern pictures, and specimens from the museum of chemistry. Second term. (3)

253. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's Commercial Organic Chemistry. Second term. (1)

254. Industrial Chemistry Conference. Discussion concerning the laboratory work of course 253. Second term. (1)

255. Agricultural Chemistry. The application of chemistry to problems in agriculture. Laboratory work. Second term. (1)

256. Sanitary Chemistry. Qualitative and quantitative examination of air, water, food, disinfectants, baking-powders, flour, bread, tea, coffee, cocoa, spices, milk, butter, lard, beer, and other subjects connected with this branch of the science. Second term. (1)

257. Thesis for the Degree of A.C. Preparation of a thesis on some subject, approved by the Professor of Chemistry, involving practical work in the laboratory and use of the library, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

Deposits to cover breakage, chemicals, etc., are required in the above courses, as follows: Ten dollars each in courses 228, 251, 253, and 255; fifteen dollars in course 256; twenty dollars each in courses 245 and 249; twenty-five dollars each in courses 230, 234, 238, and 243; thirty dollars each in courses 229, 233, 236, 237, 242, and 250; thirty-five dollars in course 247.

Summer Schools. Courses in Qualitative and Quantitative Analysis, Assaying, and Microscopy begin June 19, 1902, and continue five weeks. They are open to all persons prepared to take them.

SUMMER SCHOOLS.

The summer schools in shop inspection and sketching of machine parts, at the end of the Freshman year in the courses of Mechanical Engineering, Electrical Engineering, and Metallurgical Engineering, and in Mechanical Technology at the end of the Sophomore year in these courses, and also the summer school

in Topographic surveying in the courses of Civil Engineering, Mining Engineering, and Geology at the end of the Sophomore year are required studies and are therefore to be regarded as the summer terms of the courses. The summer schools in Engineering Laboratory and in Marine Engineering, which are held at the end of the Junior year, are optional for 1902, but thereafter will be regarded as required courses in their respective options. Likewise the instruction in Land Surveying at the end of the Freshman year is required of the students in the course in Mining Engineering, but is optional for the students in the course in Civil Engineering. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering. In addition to this required summer work, there are also summer schools in Mathematics, Strength of Materials, Chemistry, Physics, German, and French designed primarily for students of the University who are deficient in these subjects. But others not connected with the University may be admitted if properly qualified. These last mentioned summer schools, with the exception of the summer schools in Chemistry, begin in August and a special circular giving details, fee required, etc., will be sent to those applying for it.

PHYSICAL CULTURE.

All students on entering the University are required to undergo a physical examination and special exercises are prescribed for each student. During the Freshman year gymnasium exercise is required twice a week, and there is a general dumb-bell drill for students of all classes four times a week, at which attendance is optional. All exercises are under the direction and supervision of a skilled physician and are designed to promote the harmonious and symmetrical development of the individual student.

SCHOOL OF GENERAL LITERATURE.

Courses of liberal study are provided by the University in the School of General Literature. Two courses are at present offered.

1. The Classical Course.

2. The Latin-Scientific Course.

These courses differ in their entrance requirements and in their respective schedules of studies, it being the general plan that the place occupied by Greek in the Classical Course be filled in the Latin-Scientific Course with an educational equivalent in modern languages, mathematics, and natural science.

The degree of B.A. is conferred upon the graduates of either course.

It is the purpose of the University to assign in the courses of the School of General Literature a considerable amount of time to required work in the linguistic, philosophic, and scientific studies which have become the fundamental part of a liberal culture. Courses in the English, Latin, German, and French languages and their literatures, in philosophy, history, and economics, in mathematics, physics, and chemistry are required of all students. Beyond this it is the policy of the University, by allowing large freedom in the choice of studies, to make it possible for students to direct their work toward a special end. Provision is therefore made in the elective courses both for those students who, for the purpose of wider culture, wish advanced literary and philosophic studies, and for those who, having a profession in view, desire to concentrate increasingly their attention upon it.

Peculiar advantages are offered by the including among the electives of several groups of studies which belong essentially to the engineering courses of the University. The privileges of the superior technical equipment of the University are thereby extended, within reasonable limits, to all literary students, and there is afforded to studious young men, who have an engineering profession in view, an opportunity of getting both a literary and a professional education without excessive expenditure of time. A graduate of the School of General Literature may by two years of further study in an engineering course of the University, complete its requirements and gain its degree.

THE CLASSICAL COURSE.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Alg. and Solid Geom., (4)	76, 78	Trigonometry, (3)	79
Greek, (4)	29	Greek, (4)	30
Latin, (4)	20	Latin, (5)	21
Hygiene, (1)	179	English, (3)	63, 64, 67
English, (3)	61, 62, 67	English History, (2)	19

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM (*Required*).	
Greek, (4)	31	Greek, (3)	32
Latin, (4)	22	Latin, (3)	23
German, (2)	49	German, (3)	50
English, (2)	65, 68	English, (2)	66, 68
Physics, (3)	190	American History, (2)	16
Physical Laboratory, (1)	191	(*Elective, four hours*)	
		Greek, (2)	33
		Latin, (2)	24
		Projection Drawing, (3)	87
		Land Surveying, (1)	89
		Elementary Mechanics, (5)	80
		Physics, (3)	192
		Physical Laboratory, (1)	193
		Botany, (2)	175

JUNIOR YEAR.

FIRST TERM (*Required*).		SECOND TERM (*Required*).	
Psychology, (2)	1	Psychology, (2)	2
Economics, (1)	6	Economics, (1)	7
English, (1)	69	German, (2)	52
German, (2)	51	French, (2)	40
French, (2)	39	European History, (2)	15
Chemistry, (2)	227	(*Elective, seven hours*)	
Chemical Laboratory, (2)	228	Greek, (3)	35
(*Elective, five hours*)		Latin, (3)	26
Greek, (3)	34	English, (3)	71
Latin, (3)	25	American History, (2)	18
English, (3)	70	Calculus, (5)	82
American History, (2)	17	Mineralogy, (3)	146
Analytic Geometry, (5)	81	Blowpipe Analysis, (1)	147
Electric'y and Mag., (2)	194	Qualitative Analysis, (3)	230
Electrical Laboratory, (1)	195	Botany, (2)	175
Crystallography, (2)	145	Biology, (3)	177
Zoölogy, (3)	176		
*Surveying, (2)	90		

The figures in parentheses indicate the number of exercises per week.

*May be taken in the summer term after Sophomore year.

SENIOR YEAR.

FIRST TERM (*Required*).		SECOND TERM (*Required*).	
History of Philosophy, (2)	3	Hist. of Mod'n Philos'y, (2)	4
Politics, (1)	10	Politics, (1)	11
(*Elective, thirteen hours*)		Philosophy of Religion, (1)	5
Greek, (2)	36	Thesis.	
Latin, (2)	27	(*Elective, ten hours*)	
German, (2)	53	Greek, (2)	37 *or* 38
French, (2)	41	Latin, (2)	28
English, (3)	72	German, (2)	54
Economic History, (2)	8	French, (2)	42
Politics, (1)	12	English, (3)	73 *or* 74
Analytic Mechanics, (2)	83	Economics, (2)	9
Descriptive Astronomy,(3)	84	Politics, (1)	13
Architecture, (2)	106	Practical Astronomy, (2)	85
Quantitative Analysis, (3)	234	Quantitative Analysis, (4)	236
Blowpipe Analysis, (1)	148	Geology, (3)	165
Lithology, (3)	160	Botany, (2)	175
Zoölogy, (3)	176	Biology, (3)	177
Histology, (2)	177a	Alternating Currents, (2)	206
Theory of Light, (5)	198	Theory of Heat, (4)	199

THE LATIN-SCIENTIFIC COURSE.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Latin, (5)	21
Latin, (4)	20	German, (3) *or* French, (3)	52 / 42
German, (3) *or* French, (3)	51 / 41	English, (3)	63, 64, 67
English, (3)	61, 62, 67	Projection Drawing,(3)	87
Freehand Drawing, (2)	86	Land Surveying, (1)	89
Hygiene, (1)	179	English History, (2)	19

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM (*Required*).	
Latin, (4)	22	Latin, (3)	23
German, (2)	49 *or* 53	German, (2)	50 *or* 54
French, (2)	39 *or* 43	French, (2)	40 *or* 44
Physics, (3)	189	English, (2)	66, 68
Physical Laboratory, (1)	191	American History, (2)	16
Chemistry (2)	227	(*Elective, six hours*)	
Chemical Laboratory, (2)	228	Latin, (2)	24
English, (2)	65,68	Elementary Mechanics, (5)	80
		Physics, (3)	192
		Physical Laboratory, (1)	193
		Qualitative Analysis, (3)	230
		Botany, (2)	175

The figures in parentheses indicate the number of exercises per week.

JUNIOR YEAR.

FIRST TERM (*Required*).		SECOND TERM (*Required*).	
Psychology, (2)	1	Psychology, (2)	2
Economics, (1)	6	Economics, (1)	7
English, (1)	69	American History, (2)	18
American History, (2)	17	French, (2) *or* German, (2)	42 *or* 52
French, (2) *or* German, (2)	41 *or* 51	European History, (2)	15
(*Elective, eight hours*)		(*Elective, seven hours*)	
Latin, (3)	25	Latin, (3)	26
German, (2) *or* French, (2)	53 *or* 55 / 43 *or* 45	German, (2) *or* French, (2)	54 *or* 56 / 44 *or* 46
English, (3)	70	English, (3)	71
Analytic Geometry, (5)	81	Calculus, (5)	82
Elect'y and Magnet'm, (2)	194	Mineralogy, (3)	146
Electrical Laboratory, (1)	195	Blowpipe Analysis, (1)	147
Crystallography, (2)	145	Quantitative Analysis, (4)	236
Quantitative Analysis, (3)	234	Botany, (2)	175
Zoölogy, (3)	176	Biology, (3)	177
*Surveying, (2)	90		

SENIOR YEAR.

FIRST TERM (*Required*).		SECOND TERM (*Required*).	
History of Philosophy, (2)	3	Hist. of Mod'n Philos'y, (2)	4
Politics, (1)	10	Politics, (1)	11
(*Elective, thirteen hours*)		Philosophy of Religion, (1)	5
Latin, (2)	27	Thesis	
French, (2)	45 *or* 47	(*Elective, ten hours*)	
German, (2)	55 *or* 57	Latin, (2)	28
English, (3)	72	French, (2)	46 *or* 48
Economic History, (2)	8	German, (2)	56 *or* 58
Politics, (1)	12	English, (3)	73 *or* 74
Analytic Mechanics, (2)	83	Economics, (2)	9
Architecture, (2)	106	Politics, (1)	13
Descriptive Astronomy, (3)	84	Practical Astronomy, (2)	85
Blowpipe Analysis, (1)	148	Geology, (3)	165
Lithology, (3)	160	Botany, (2)	175
Zoölogy, (3)	176	Biology, (2)	177
Histology, (2)	177a	Alternating Currents, (2)	206
Theory of Light, (5)	198	Theory of Heat, (4)	199

The figures in parentheses indicate the number of exercises per week.
*May be taken in the summer term after Sophomore year.

THE COURSE IN CIVIL ENGINEERING.

The requirements for admission to this course may be found on pages 23 and 24. While French will be accepted instead of German, it is recommended that the latter be offered, as its technical literature is of greater value to the civil engineer.

The program of studies of this course, given on page 74, shows the subjects required to be completed by candidates for the degree of Civil Engineer. The numbers following the subjects refer to the detailed descriptions on pages 35 to 65. The figures in parentheses indicate the number of exercises per week.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology and special training in those subjects comprised under the term civil engineering. The graduate is not only prepared to enter upon the location and construction work of railroads, bridges, water works, or sewerage plants, but can advantageously take up allied work in mining, mechanical, electrical, or architectural engineering.

During the Freshman year the time is mostly devoted to fundamental studies which give both general culture and preparation for the technical work of the following years. The study of Mathematics, Physics, English, and German is continued. Chemistry is taught partly by lectures and partly by practical manipulation in the laboratory. Drawing is done throughout the year, freehand sketching in the first term and instrumental work in the second. There are lectures in Physiology and Hygiene, and systematic exercise in the gymnasium is required.

In the Sophomore year the fundamental subjects of Mathematics, Physics, and English are completed and the technical work of civil engineering is begun by practical problems in Structural Drawing and by lectures on Construction. During the Junior and Senior years the time is mostly devoted to professional studies, but there are lectures on Economics and on Philosophy, and the student has an opportunity of electing subjects which lead on the one hand in the direction of architecture and on the other hand in the direction of mining and metallurgy. The theory of Land Surveying is begun in the Freshman year, while the field work and drawing are done in the Sophomore year. Those who desire to take the field work and drawing during the Summer term at the end of the Freshman year are allowed to do so under the regulations stated on page 46. All

the work in Topographic Surveying is done in four weeks following the end of the Sophomore year. By this arrangement the attention of the student is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying both preliminary and final locations of a line are made, and plans, profiles, and estimates of cost are prepared. In Geodetic Surveying triangulations of a high degree of precision are executed, as also determinations of azimuth, and adjustments of the results are made by the standard methods. A large collection of levels, transits, and other surveying tools enables the student to become familiar with the instruments of the best manufacturers.

Under the head of Construction are grouped the topics of masonry, foundations, roads and pavements, cements and mortars, walls, dams, arches, tunnels, and details of structures. The work covers three terms and is mainly by lectures, with references to standard books and engineering journals. Many visits of inspection to structures in the Lehigh Valley and vicinity are made, and written reports upon them are required. All the standard tests of cements and mortars are made by each student. In connection with the subject of Strength of Materials there is also work in the testing laboratory on timber, brick, iron, and steel.

Roofs and Bridges receive attention throughout five terms. The analysis of trusses by graphic methods is begun in the Sophomore year, and in the following year the analytical methods of computing stresses are taken up. Visits are made to bridges and sketches taken of details which are afterwards drawn to scale. Later, designs and working drawings are prepared by each student for both highway and railroad bridges. These drawings are made, dimensioned, and checked in the same manner as in the drafting room of a bridge company, and estimates of the final weight of the structure are prepared. The theory of cantilever, draw, suspension, and arched structures also receives detailed attention. This extended training in bridge engineering furnishes a thorough foundation for successful work in practice.

Hydraulic and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes, and channels, together with the principles of hydraulic motors, is given in the Junior year, while in the Senior year the subjects of water supply and sewerage are discussed. The methods of collecting, purifying, and distributing water are explained and

compared; house drainage, the design of sewerage systems, and the disposal of sewage also receive attention. Visits of inspection to water works are made and detailed reports upon them are prepared. Computations for dams, standpipes, sewers and their appurtenances are made. Canal engineering, river and harbor work, and land drainage receive attention. Irrigation by both water and sewage is also discussed. This training in Hydraulic and Sanitary subjects, together with that in Construction, renders the graduate well qualified to enter upon the work of city engineering.

Among other required subjects may be noted that of Strength of Materials, which gives the theory of beams, columns, and shafts, and the methods of computing and designing them; as already noted, this subject is exemplified by practical work in the testing laboratory. The subject of Mechanics of Machinery treats of cranes, elevators, and locomotives, and that of Electric Railroads of the equipment and operation of trolley roads.

During the Junior and Senior years there are sixteen subjects offered, of which eight are to be elected by the student. Those intending to work in the line of architectural engineering will naturally select Perspective, Heating and Ventilation, and Architectural Design, while those wishing to work in the direction of mining and metallurgy will select Mineralogy, Lithology, Geology, and the Metallurgy of Iron. Other elective subjects are Steam Engine, Railroad Construction, and an advanced course in Materials of Construction, with special reference to inspection and testing. In these subjects, as well as in all the work of this course, it is the aim to exemplify the theoretical principles by practical problems, inspections, designs or laboratory exercises. The testing laboratory of the University contains machines for making physical tests of tension, compression, flexure and torsion, and is of special value to students who select theses on investigations on the properties of materials. During the past year a 100,000-pound Riehlé testing machine, equipped with autographic recording and automatic speed apparatus, has been installed in the laboratory.

The student who completes this course will receive the degree of Civil Engineer. Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 27.

THE COURSE IN CIVIL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Elementary Mechanics, (5)	80
Chemistry, (4)	227, 228	Physics, (2)	187
German, (3) *or*	51	Physical Laboratory, (1)	188
French, (3)	41	Projection Drawing, (3)	87
Freehand Drawing, (2)	86	Land Surveying, (1)	89
Hygiene, (1)	179	German, (3) *or*	52
English, (3)	61, 62, 67	French, (3)	42
		English, (3)	63, 64, 67

SUMMER TERM.

Land Surveying (optional), 90.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	81	Calculus, (5)	82
Physics, (4)	189, 191	Physics, (4)	192, 193
Construction, (2)	94	Construction, (3)	95
Land Surveying, (2)	90	Graphic Statics, (3)	101
Structural Drawing, (2)	88	English, (2)	66, 68
English, (2)	65, 68		

SUMMER TERM.

Topographic Surveying, 91.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Descriptive Astronomy, (3)	84	Railroad Surveying, (4)	92
Strength of Materials, (4)	98	Hydraulics, (3)	111
Construction, (3)	96	Roofs and Bridges, (4)	103
Bridge Design, (4)	102	Economics, (1)	7
Economics, (1)	6	Perspective, (3) *or*	107
Architecture, (2) *or*	106	Mineralogy, (3)	140
Crystallography, (2)	139	Railroads, (2) *or*	97
		Practical Astronomy, (2)	85

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Geodetic Surveying, (3)	93	Bridges, (3)	105
Bridge Design, (4)	104	Electric Railways, (2)	225
Sanitary Engineering, (4)	112	Philosophy of Religion, (1)	5
Mechanics of Machin'y, (2)	133	Geology, (3) *or*	165
Lithology, (2) *or*	161	Steam Engine, (3)	119
Architectural Design, (2)	108	Metallurgy, (5) *or*	153
Materials, (2) *or*	99	Architect'l Design, (5)	109
Heating and Vent'n, (2)	110	Thesis, (3)	113

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: the nature, equivalence, and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, mechanical technology, the principles and practice of machine design, and the measurement of power.

The earliest shop visits are for the purpose of acquainting beginners with machine parts and the usual tools of a shop. These visits are a part of the work of a Summer Term, lasting four weeks, which is held at the close of the second term of Freshman year.

In this same Summer Term the students of Mechanical Engineering are also given a course in the examination of electrical instruments and machinery and in the inspection of their use and operation in electrical plants. This is regarded as a very desirable preliminary to the study of Physics and to the special course in Electrical Engineering which they pursue later on.

A second Summer Term at the end of the Sophomore year provides a course of shop instruction (Mechanical Technology) which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing the student with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery.

During the course there are frequent visits of inspection to the Bethlehem Steel Company, to the L. V. R. R. shops at Easton, and to other engineering works both in and out of town, with special reference to such subjects as prime movers, machinery for lifting, handling, and transporting, and machinery for changing the form and size of materials.

The instruction in Machine Design begins with the second term of the Freshman year and is continued throughout the course. At first tracings and blue-prints of good examples of drawings of machinery are made. A thorough drill in projection drawing follows; in this work freehand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-sized drawings. Then there is considerable practice in the interpretation of such drawings, and general views of lathes, planers, drills, and shapers are

made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high-speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year, the students undertake the calculations, estimates, and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. In the case of these machines and of the engine the general plan of arrangement will be given to the students in the form of rough sketches, photographs, or woodcuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained.

The students in Mechanical Engineering are given a special course in Electrical Engineering after they have finished the regular and general course in Physics. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, inductance, reactance, capacity, and the magnetism of iron, and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena, and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy, and efficiency. Instruction is also given in locating and remedying the common faults of dynamos and motors.

The course in Engineering Laboratory consists at first in the calibration of mechanical engineering measuring instruments, then in experiments on the flow of fluids, then in the determination of the mechanical efficiencies of transmitting gear and of special machines. This is followed by a Summer term of four weeks devoted entirely to experimental work, which includes the testing of an air compressor, of turbines, of water and electric motors, of hot air and gas engines, of steam generators and of simple and multiple-cylinder engines. Finally

the students are required to undertake complete tests of some of the power plants of the vicinity. For this course of work there is available the newly constructed Steam Engineering Laboratory and the additional space reserved in the new Physical Laboratory for the experimental apparatus, machinery, and motors presented by Mr. Warren A. Wilbur to the department of Mechanical Engineering.

In the Junior and Senior years Marine Engineering is offered as an optional course to the students of this department. This course concerns itself mainly with the Engine or Power Department of Shipbuilding, and is treated as an advanced portion of Steam Engineering and Applied Mechanics. The available time is, therefore, principally devoted to Marine Boilers and their accessories, to Marine Engines, both main and auxiliary, and to the Theory of the Screw Propeller. The time remaining is given to the Hull Department of Shipbuilding by the study of the Mechanics of Flotation and Stability, and to the Resistance and Steering of Ships. At the end of the Junior year there is a summer term of four weeks devoted to inspection and study of the ships, shops, and yards of shipbuilding establishments.

All the students in this course are required to study both German and French.

The graduates in this course will receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Elementary Mechanics, (5)	80
Chemistry, (2)	227	Physics, (2)	187
Chemical Laboratory, (2)	228	Physical Laboratory, (1)	188
German, (3) *or* French, (3)	41 / 51	Draw'g and Mach. Des'n, (3)	114
Freehand Drawing, (2)	86	German, (3) *or* French, (3)	52 / 42
Hygiene, (1)	179	English, (3)	63, 64, 67
English, (3)	61, 62, 67		

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 115 and 203.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	81	Calculus, (5)	82
Physics, (3)	189	Physics, (3)	192
Physical Laboratory, (1)	191	Physical Laboratory, (1)	193
Machine Design, (3)	116	Steam Engine, (4)	118
Boilers, (1)	117	French, (2) *or* German, (2)	40 / 50
French, (2) *or* German, (2)	39 / 49	English, (2)	66, 68
English, (2)	65, 68		

SUMMER TERM.

Mechanical Technology, 120.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Mechanics, (2)	83	Graphic Dynamics, (3)	123
Mechanics of Machin'y, (2)	121	Mechanics of Machin'y, (3)	125
Dynamos and Motors, (2)	205	Hydraulics, (3)	111
Elect'y and Magnet'm, (2)	194	Elect'l Engineering, (2)	208
Electrical Laboratory, (1)	195	Dynamo Laboratory, (1)	222
Engineer'g Laboratory, (1)	122	Engineer'g Laboratory, (1)	124
Strength of Materials, (4)	98	Economics, (1)	7
Economics, (1)	6	French, (2) *or* German, (2)	42 / 52
French, (2) *or* German, (2)	41 / 51	OPTIONS.	
		Alt'nat'g Cur'nts, (2) *or* Marine Eng'er'g, (2)	206 / 136

SUMMER TERM.

Engineering Laboratory, 126, *or* Constructive Elements of Ships, 127 (corresponding to preceding options).

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Thermodynamics, (3)	128	Machine Design, (5)	137
Kinematics of Mach'ry, (5)	129	Engineer'g Laboratory, (1)	139
Machine Design, (4)	130	Metallurgy, (3)	155
Engineer'g Laboratory, (1)	132	Philosophy of Religion, (1)	5
OPTIONS.		Thesis, (3)	144
Graphic Statics, (2) / Mech. of Mach, (2)	100 / 133	OPTIONS.	
or		Mech. of Mach., (4)	140
Marine Engineering, (1)	134	*or*	
Marine Engineering, (2)	135	Marine Engineering, (2)	141
Marine Engineering, (1)	142	Marine Engineering, (2)	143

A special option in Electrical Engineering may be arranged.

THE COURSE IN METALLURGICAL ENGINEERING.

This course is designed to prepare the student for practice in the field of Metallurgy. In addition to the general studies underlying all technical education, instruction is given in Freehand and Projection Drawing, the Strength of Materials, including work in the testing laboratory, Graphic Statics, as applied to roof trusses and girders, Mechanical Technology, Steam Boilers, The Steam Engine, The Mechanics of Machinery, involving the study of hoisting and pumping engines, air compressors, blowing engines, fans, etc., The Measurement of Power, Hydraulics, including hydraulic motors and Electrotechnology, including the theory of electric motors and dynamos and laboratory work in electrical measurements. The student is thus made acquainted with the principles involved in the design and construction of the buildings and machinery constituting a metallurgical plant and in the operation of the machines.

A thorough course is given in Physics, including laboratory work in mechanics and calorimetry.

In Chemistry, in addition to the training in chemical theory involved in the courses of Stoichiometry and Chemical Philosophy, much time is devoted to work in the laboratory, involving the qualitative and quantitative analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including gas analysis and dry assaying. The student is thus made thoroughly familiar with the principles of the two chief sciences on which the operations of metallurgy are based and with the methods of analysis employed in the laboratories of smelting works.

Courses in Mineralogy and Blowpipe Analysis involve practice in the identification of crystals and of minerals by their physical properties and their behavior before the blowpipe. The mineralogical laboratory affords facilities for advanced courses in geometric and physical crystallography which are not included in the ordinary curriculum. An elective course in Quantitative Blowpipe Analysis is open to a limited number of students.

A course in Lithology gives practice in the identification of rocks and is followed by courses in Historic, Dynamic and Economic Geology.

A course in Ore Dressing renders the student familiar with the principles and methods of the mechanical preparation of ores and fuels.

The special instruction in Metallurgy is begun by a course in Metallurgical Construction. The class is taken on visits of inspection to neighboring metallurgical works. Each student makes sketches and takes notes of an assigned portion of the plant. From these working drawings are made and memoirs written describing and discussing the plant inspected. The student is thus rendered familiar with the furnaces and apparatus employed in metallurgical establishments, and with the methods in use in their drafting rooms. Courses of lectures in Metallurgy extend throughout a year. In these the chief weight is laid upon the chemical and physical principles involved in the various metallurgical processes. In order to impress these principles upon the mind of the student and to render their application familiar he is required to solve a series of problems which embody them. The problems are chiefly such as confront the metallurgist in his practice. In the course of Metallurgical Design the class is required to design a metallurgical plant to be operated under given conditions, a certain portion being assigned to each student. This involves calculations of stresses, weights and costs, the execution of working drawings and the discussion of the methods and apparatus chosen.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with Metallurgy to such advanced students as are competent to conduct them.

The vicinity of the works of the Bethlehem Steel Company and of the New Jersey Zinc Company, and the kindness of their officers, give opportunities for frequent visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and of zinc. Occasional visits of inspection are made to more distant works.

The graduate of this course will receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Elementary Mechanics, (5)	80
Chemistry, (2)	227	Physics, (2)	187
Chemical Laboratory, (2)	228	Physical Laboratory, (1)	188
German, (3) *or*	51	Qualitative Analysis, (3)	230
French, (3)	41	Stoichiometry, (2)	231
Freehand Drawing, (2)	86	German, (3) *or*	52
Hygiene, (1)	179	French, (3)	42
English, (3)	61, 62, 67	English, (3)	63, 64, 67

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 115 and 203.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	81	Calculus, (5)	82
Physics, (3)	189	Physics, (3)	192
Physical Laboratory, (1)	191	Physical Laboratory, (1)	193
Drawing, (3)	150	Blowpipe Analysis, (1)	147
Metallurgical Constr., (1)	151	Mineralogy, (3)	146
Crystallography, (2)	145	Metallurgical Constr., (2)	151
English, (2)	65, 68	Drawing, (1)	150
		English, (2)	66, 68

SUMMER TERM.

Mechanical Technology, 120.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	98	Metallurgy, (5)	153
Boilers, (1)	117	Steam Engine, (4)	118
Lithology, (3)	160	Geology, (3)	165
Blowpipe Analysis, (1)	148	Quantitative Analysis, (4)	238
Chemical Philosophy, (3)	232	Economics, (1)	7
Quantitative Analysis, (3)	234		
Economics, (1)	6		
English, (1)	69		

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	155	Mech. of Mach., (4)	140
Assaying, (3)	250	Metallurgical Design, (2)	152
Quantitative Analysis, (3)	243	Metallurgical Lab'r'y, (1)	155a
Electrotechnology, (2)	216	Ore Dressing, (3)	183
Graphic Statics, (2)	100	Hydraulics, (3)	111
Economic Geology, (2)	169	Engineering Labora'y, (1)	124
Engineer'g Laboratory, (1)	122	Philosophy of Religion, (1)	5
		Thesis,	158

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTROMETALLURGY.

This course is designed to prepare the student to enter the rapidly developing fields of electrometallurgy and electrochemistry.

For the first two years the course is identical with that in Metallurgical Engineering, embracing fundamental instruction in mathematics, physics, mineralogy, drawing, and modern languages. In the third and fourth years this course agrees with the Metallurgical Engineering course in the inclusion of chemical analysis, chemical philosophy, metallurgy, ore dressing, boilers, steam engine, measurement of power, and the general culture studies; it differs from it by devoting less time to quantitative analysis and assaying, by omitting certain courses in Civil and Mechanical Engineering, and by devoting the time thus gained to electrical and electrochemical subjects. The subjects thus introduced are Advanced Theory of Electricity and Magnetism, with practical work in measurement of current resistance, electromotive force, inductive capacity, magnetic testing of iron, etc.; Theory of Direct and Alternating-Current Dynamos and Motors, with experimental studies and tests, Electrical Generating Stations, Transmission and Receiving Systems; Theory of Electrolysis and Principles of Electrometallurgical and Electrochemical Practice, with experimental studies and tests in the laboratory.

The graduate of this course will receive the degree of Electrometallurgist (El.Met.).

THF COURSE IN ELECTROMETALLURGY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Elementary Mech., (5)	80
Chemistry, (2)	227	Physics, (2)	187
Chemical Laboratory, (2)	228	Physical Laboratory, (1)	188
German, (3) *or* French, (3)	51 / 41	Qualitative Analysis, (3)	230
		Stoichiometry, (2)	231
Freehand Drawing, (2)	86	German, (3) *or* French, (3)	52 / 42
Hygiene, (1)	179		
English, (3)	61, 62, 67	English, (3)	63, 64, 67

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 115, 203.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	81	Calculus, (5)	82
Physics, (3)	189	Physics, (3)	192
Physical Laboratory, (1)	191	Physical Laboratory, (1)	193
Drawing, (4)	150	Blowpipe Analysis, (1)	147
Crystallography, (2)	145	Mineralogy, (3)	146
English, (2)	65, 68	Metallurgical Constr., (4)	151
		English, (2)	66, 68

SUMMER TERM.

Mechanical Technology, 120.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Strength of Materials, (4)	98	Metallurgy, (5)	153
Boilers, (1)	117	Steam Engine, (3)	119
Chemical Philosophy, (3)	232	Quantitative Analysis, (4)	238
Quantitative Analysis, (3)	234	Alternating Currents, (2)	206
Blowpipe Analysis, (1)	148	Electrical Engineer'g, (2)	207
Electr'y and Magnet'm, (2)	194	Electrical Laboratory, (1)	196
Electrical Laboratory, (1)	195		
Dynamos and Motors, (2)	204		
English, (1)	69		

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	155	Metallurgical Design, (2)	152
Quantitative Analysis, (3)	243	Ore Dressing, (3)	183
Blowpipe Analysis, (1)	149	Engin. Laboratory, (1)	139
Engineer'g Laboratory, (1)	132	Electric Power, (2)	220
Electric Lighting, (2)	212	Dynamo Laboratory, (2)	224
Dynamo Laboratory, (2)	215	Electrometallurgy, (1)	157
Theory of Electrolysis, (1)	156	Metallur. Laboratory, (1)	155a
Electrical Laboratory, (1)	217	Economics, (1)	7
Electromet. Lab., (1)	157a	Philosophy of Religion, (1)	5
Economics, (1)	6	Thesis	159

THE COURSE IN MINING ENGINEERING.

In developing this course, the following objects have been kept in view, in order that the graduate may be enabled—

1. To make surface or underground surveys, and to map the physiography and geology of a region.

2. To recognize readily by inspection the mineral bodies encountered in a survey; to value outcrops and properties; and to analyze given substances by wet, dry, or blowpipe methods, rather from the economic standpoint of the engineer than from the analytical one of a metallurgical chemist.

3. To make mining or metallurgical designs and constructions to meet the requirements of given cases.

After laying a thorough foundation in mathematics, physics, English, and modern languages, the ability to execute the first of the preceding objects is secured by courses in land, topographical, mine, geodetic, and geological surveying, including field work in the same; the second, by laboratory work in crystallography, mineralogy, microscopic petrography, chemical analysis, assaying and blowpiping, and by a course in economic geology, prospecting and the valuation of properties; the third, by extensive courses in strength of materials, graphical statics of trusses and mechanisms, hydraulics, mechanics of machinery, steam engine, measurement of power, mining, ore-dressing, metallurgy, and electrometallurgy, supplemented by visits to mining and metallurgical plants, which may furnish data for problems to be solved by courses in design based upon extensive practice in drawing, construction and graphical analysis. The school conducted during the summer of the Junior year in the coal regions enables the student to acquire practice in mine surveying and field geology and to fill a note book with sketches and details of plant, which are subsequently utilized in the mining design of the term immediately following.

The natural sciences of the course are taught in an eminently practical manner. The theory is first developed and then fully illustrated in such a manner that the student is carried forward, noting, identifying, and comparing as he proceeds. In Crystallography he handles accurately made models, applies the goniometer, and constructs the zone equation. From the necessary data he draws the crystal according to the best methods. In Mineralogy he handles carefully selected specimens and, after learning the methods of identification by physical peculiarities,

is taught to check these by blowpipe tests. In Petrology he masters the methods by the microscope; carries the mineral analysis one step further and applies these methods to determining the species of rocks which are of common and also of infrequent occurrences. In Geology these methods of discrimination and powers of classifying are directed to the study of the causes which have deformed or degraded the terranes which are brought to his notice, or to type fossils by which they are identified. After mastering these principles the student applies them in the field so that after graduation he should readily determine any rock, and approximately place any fossiliferous outcrop. These powers, combined with the knowledge of Economic Geology, will be directly valuable in a prospect or a geological survey.

The facilities for the study of economic geology and mining are almost unequalled, as within easy reach are mines of zinc ore, paint ore, brown hematite, magnetite, block and fossil hematites, and the great anthracite coal fields of the State; while quarries of limestone, sand, slate, and cement lie immediately in the vicinity of the University. The mechanical and metallurgical facilities are almost equally good, as in the same borough are the great armor, gun, and machine works of the Bethlehem Steel Co., and the spelter and oxide works of the New Jersey Zinc Co.

THE COURSE IN MINING ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Elementary Mechanics, (5)	80
Chemistry, (2)	227	Physics, (2)	187
Chemical Laboratory, (2)	228	Physical Laboratory, (1)	188
German, (3) *or* French, (3)	51 / 41	Qualitative Analysis, (3)	230
		Stoichiometry, (2)	231
Freehand Drawing, (2)	86	Land Surveying, (1)	89
Mechanical Drawing, (3)	185	German, (3) *or* French, (3)	52 / 42
Hygiene, (1)	179		
English, (3)	61, 62, 67	English, (3)	63, 64, 67

SUMMER TERM.

Land Surveying, 90.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	81	Calculus, (5)	82
Physics, (3)	189	Physics, (3)	192
Physical Laboratory, (1)	191	Physical Laboratory, (1)	193
Crystallography, (2)	145	Mineralogy, (3)	146
Quantitative Analysis, (3)	234	Blowpipe Analysis, (1)	147
Chemical Philosophy, (3)	232	Quantitative Analysis, (3)	243
English, (2)	65, 68	Petrology, (2)	162
		English, (2)	66, 68

SUMMER TERM.

Topographic Surveying, 91.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgical Constr., (3)	151	Mining Engineering, (3)	180
Geology, (2)	166	Mining, (2)	181
Assaying, (3)	250	Metallurgy, (5)	153
Strength of Materials, (4)	98	Geology, (2)	167
Petrology, (2)	163	Steam Engine, (4)	118
Blowpipe Analysis, (1)	148	Hydraulics, (3)	111

OPTIONS.

Zoölogy, (3) *or*	176
Astronomy, (3)	84

SUMMER TERM.

Mine Surveying, 184, in summer of 1903.

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Mining Engineering, (3)	182	Mining Engineering, (3)	183
Metallurgy, (4)	155	Metallurgical Design, (2)	152
Mining Design, (2)	185a	Mechan. of Machin'y, (4)	140
Mechan. of Mach'y, (2)	121	Electrometallurgy, (1)	157
Graphic Statics, (2)	100	Philosophy of Religion, (1)	5
Engin. Laboratory, (1)	122	Economics, (1)	7
Economics, (1)	6	Geolog. Surveying, (2)	173
OPTIONS.		Engin. Laboratory, (1)	124
Geodetic Surveying, (3) *or*	93	Thesis,	186
Economic Geology, (2)	169		

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN ELECTRICAL ENGINEERING.

The object of this course is to give to the student a broad technical education with special reference to the requirements of Electrical Engineering. The course includes those general culture studies and those mathematical and scientific studies which constitute the basis of a sound technical education, and it affords special training in the various branches of electrotechnology and in closely allied branches of Mechanical and Civil Engineering. Students who complete the course receive the degree of Electrical Engineer (E.E.).

Electives are offered during the Junior and Senior years, which enable the student to give to his course a trend towards Mechanical or Metallurgical Engineering, as he may desire. The student is required to indicate to the head of the Electrical Engineering department his choice of these electives, series (*a*) or series (*b*), on or before the 15th of December during the first term of his Junior year.

The Electrical Engineering department library and reading room, located on the main floor of the department building, is provided with the leading electrical periodicals, with files of trade catalogues and circulars, and with standard reference books.

After consultation with the head of the Electrical Engineering department a part, not exceeding one-fourth, of the special work in electrotechnology may be replaced by an equivalent amount of work in Mechanical Engineering.

Opportunities for graduate study are offered by the Department of Physics and Electrical Engineering in the following subjects: Advanced Theory of Alternating Currents, Experimental Researches in Electrical Engineering, Theoretical Physics, and Physical Research.

THE COURSE IN ELECTRICAL ENGINEERING.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Elementary Mechanics, (5)	80
Chemistry, (2)	227	Physics, (2)	187
Chemical Laboratory, (2)	228	Physical Laboratory, (1)	188
German, (3) *or* French, (3)	51 / 41	Draw'g and Mach. Des'n, (3)	114
Freehand Drawing, (2)	86	German, (3) *or* French, (3)	52 / 42
Hygiene, (1)	179	English, (3)	63, 64, 67
English, (3)	61, 62, 67		

SUMMER TERM.

Constructive Elements of Machinery and of Electrical Apparatus, 115 and 203.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	81	Calculus, (5)	82
Physics, (3)	189	Physics, (3)	192
Physical Laboratory, (1)	191	Physical Laboratory, (1)	193
Machine Design, (3)	116	Steam Engine, (4)	118
Boilers, (1)	117	German, (2) *or*	54
German, (2) *or*	53	French, (2)	44
French, (2)	43	English, (2)	66, 68
English, (2)	65, 68		

SUMMER TERM.

Mechanical Technology, 120.

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Mechanics, (2)	83	Elec. Engineering, (2)	207
Elec'y and Magnet'm, (2)	194	Alternating Currents, (2)	206
Dynamos and Motors, (2)	204	Elec. Laboratory, (2)	196
Elec. Laboratory, (1)	195	Hydraulics, (3)	111
Strength of Materials, (4)	98	Construction, (2)	95
Mech. of Machin'y, (2)	121	Economics, (1)	7
Construction, (2)	94	(*Elective, 5 or 6 hours.*)	
Economics, (1)	6	Mechan. of Mach'y, (3)	123
English, (1)	69	Graphic Dynamics, (3)	125
		or	
		Metallurgy, (5)	153

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Theory of Alt. Cur., (2)	209	Theory of Alt. Cur., (2)	218
Dynamo Elec. Mach'y, (2)	210	Electrical Design, (2)	219
Electrical Design, (2)	211	Electric Power, (2)	220
Electric Lighting, (2)	212	Dynamo Laboratory, (3)	222
Teleg's and Telephones, (2)	214	Electrical Seminary, (1)	221
Dynamo Laboratory, (2)	215	Electrometallurgy, (1)	157
Electrical Seminary, (1)	213	Philosophy of Religion, (1)	5
Engin. Laboratory, (1)	122	Thesis, (3)	226
(*Elective, two hours.*)		(*Elective, two hours.*)	
Machine Design, (2)	131	Machine Design, (2) *or*	138
or		Metallurg'l Design, (2)	152
Theory of Electrol., (1)	156		
Elec. Laboratory, (1)	217		

A special option in Mechanical Engineering may be arranged.

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the professional chemist. It is also well adapted to the preparation of teachers of chemistry and as a course preliminary to the study of medicine.

Instruction in Theoretical Chemistry begins in the first term of the Freshman year, with laboratory work in general inorganic chemistry. Stoichiometry, with practice in chemical problems, is taught in the second term of the Freshman year and is followed in the Sophomore year by Chemical Philosophy and Theoretical Chemistry. In the first term of the Junior year there is a course of lectures and recitations on theoretical organic chemistry.

Qualitative Analysis is taught by lectures and laboratory work in the second term of the Freshman year. This is followed by courses in Quantitative Analysis throughout the Sophomore and first term of the Junior year. This course includes Gas Analysis. Furnace Assaying and the Assay of gold and silver bullion are taught in the first term of the Senior year by lectures and laboratory work. The analysis of various commercial products is taken up in the second term of the Senior year, also the subjects of Sanitary and Agricultural Chemistry and Toxicology. Instruction is also given in Manufacturing Chemistry, Dyeing, Calico Printing, and Bleaching. Blowpipe analysis also is included in the course.

The practical work in Organic Chemistry is performed in the second term of the Junior year, with laboratory work and conference. There are also courses of practical Microscopy and Photography and lectures upon Industrial Chemistry, including Electrochemistry, and Toxicology. In the Senior year the student prepares a thesis on some chemical subject, involving laboratory work.

The laboratory for qualitative analysis is a large, well-ventilated, and well-lighted room, supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths,

gas and washing appliances, and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories.

The quantitative laboratory is equipped like the qualitative laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

The gas laboratory is supplied with full and complete apparatus for gas analysis, according to Orsat's, Hemple's, and Bunsen's processes.

The assaying laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

The laboratory for organic chemistry is equipped similarly to the quantitative laboratory, in addition being supplied with steam, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas's, and Meyer's apparatus for vapor densities, nitrometers, chemical balances, etc.

The working laboratories for industrial chemistry contain an apparatus for making illuminating gas, an alcohol still, worm and doubler, and a complete working model of a sugar refinery, including filters, vacuum pan, and centrifugal. There is also apparatus for use in the manufacture of chemicals, for dyeing, calico printing, and bleaching. In connection with these laboratories is a room containing a photometer and apparatus for determining the sulphur, ammonia, and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates, tallow, illuminating and lubricating oils, rubber, explosives, asphalts, and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City. A well equipped photographic laboratory and dark rooms are provided, in which the students of the Chemical course receive practical instruction. There is also a course in Microscopy.

THE COURSE IN CHEMISTRY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Qualitative Analysis, (6)	229
Chemistry, (2)	227	Stoichiometry, (2)	231
Chem. Laboratory, (2)	228	Physics, (2)	187
German, (3) *or*	51	Physical Laboratory, (1)	188
French, (3)	41	German, (3) *or*	52
Freehand Drawing, (2)	86	French, (3)	42
Hygiene, (1)	179	English, (3)	61, 65
English, (3)	61, 62, 67		

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Chem. Philosophy, (3)	232	Physics, (3)	192
Quantitative Analysis, (6)	233	Physical Laboratory, (1)	193
Quant. Anal. Conf., (1)	235	Quantitative Analysis, (6)	237
Physics, (3)	189	Quant. Anal. Conf., (1)	239
Physical Laboratory, (1)	191	Theoretical Chemistry, (3)	240
English, (2)	65, 68	English, (2)	66, 68

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Toxicology, (2)	241	Organic Chemistry, (6)	247
Quantitative Analysis, (6)	242	Org. Chem. Conf., (1)	248
Quant. Anal. Conf., (1)	244	Metallurgy, (5)	153
Organic Chemistry, (4)	246	Mineralogy, (3)	146
Crystallography, (2)	145	Blowpipe Analysis, (1)	147
Economics, (1)	6	Economics, (1)	7
English, (1)	69		

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Metallurgy, (4)	155	Industrial Chemistry, (3)	252
Assaying, (3)	250	Industrial Analysis, (3)	253
Industrial Chemistry, (3)	249	Ind. Chem. Conf., (1)	254
Lithology, (3)	160	Agricultural Chem., (1)	255
Microscopy, (2)	251	Sanitary Chemistry, (1)	256
Blowpipe Analysis, (1)	148	Geology, (3)	165
		Philosophy of Religion, (1)	5
		Thesis, (3)	257

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN GEOLOGY.

The course in Geology is the same as that in Mining Engineering up to the end of the Sophomore year and differs in only a few respects from it up to the end of the first term Junior year. It is designed for those who wish the thorough grounding of the engineering courses, but whose tastes lead them into the natural sciences rather than into technical lines. The studies for the first two years are equally necessary for the thoroughly educated man in either, and by this arrangement the student is not required to decide which course he will follow until he has had an opportunity to test his own tastes and abilities.

After completing the course in Geology one year of graduate work will enable the student to secure the degree of Engineer of Mines and the graduate from the Mining Engineering course in the same way, by taking a year's work in the geological specialties as a major subject with the addition of a minor subject from another department, can complete the course in Geology and receive the degree of Master of Science.

The course meets the requirements of the teacher of the natural sciences, the field geologist, or the prospecting and exploring engineer, and furnishes especially a broad, thorough basis for the subsequent prosecution of original research. Throughout the entire four years the work gives a first-hand knowledge of the subjects taught and cultivates self-reliance and the powers of perception and exact reasoning. For those who may wish ultimately to become specialists in some one of the diverse branches of Geology this course is recommended with a year of graduate work at one of the larger Universities.

It includes all of the Mathematics and Physics taught in the technical courses, thus ensuring an ability to grasp and solve the problems of geological dynamics. A year's knowledge of French or German is necessary for entrance and this is continued by a year and a half of work in the same language. Two years' work in the other language is required during the Junior and Senior years, so that by the end of the course the student feels at home with foreign periodical literature in both French and German.

A thorough knowledge of Surveying is considered at the present time indispensable to the field geologist, and the courses, being the same as those for the mining engineer, not only offer

a ready means of livelihood for young men just graduated, but afford practice in accurate mapping and give the proper basis for the interpretation of topography. The course in geodesy gives the methods of triangulation and the adjustment by least squares.

The preliminary courses in Crystallography, Mineralogy, Petrology, and Geology are the same as those given to the mining engineers and will permit the student with slight effort not only to recognize any of the constituents of the earth's crust, but to value the portion surveyed from an economic standpoint as it is adapted or not for mining operations. In addition to these are the more purely scientific courses. Throughout the Junior year three periods a week are set aside for field Geology to accompany the first year's work. The Petrology is continued through the second term Junior year; the student, having passed briefly over the general subject of Petrology, spends this time in studying some particular phases and becoming familiar with detailed methods which cannot be given in the briefer course. A course in advanced Geology devoted chiefly to Paleontology runs through the Senior year, a text-book being used and the student handling and identifying numerous invertebrate fossils. It is not designed to make a paleontologist, but to give that amount of systematic knowledge and ability to identify fossils which should be possessed by the stratigraphical geologist or to give a basis for one who wishes to pursue the subject further.

The several branches of Geology are so widely separated and require such different kinds of ability that in the second term Senior year an opportunity is given for the student to specialize. In the studies in Pennsylvania Geology he takes up some branch of the subject, reads the literature that bears upon it, and makes field studies over regions within reasonable distances. Original research is more properly left for graduate work, but this course is preparatory to it by showing the student the depth to which he must go before hoping to turn out new material. Some phases of the subject, however, embracing his own observations and deductions may properly be handed in for a thesis.

The ordinary courses in Geology are extended by excursions into the foundations of Botany, Zoölogy, and Biology, and supplemented by work in the field in the courses in Surveying and Physiography. The ability readily to determine the character and value of the ores and minerals met with is guaranteed by extended courses in Crystallography, Mineralogy, Megascopic and Microscopic Rock Analysis, Economic Geology, and both Chemi-

cal and Blowpipe Analysis. The course in Chemistry includes assaying, quantitative wet analysis and the discussion of chemical problems, so that mineralogical formulæ can be calculated from the results of analyses. The blowpipe courses cover qualitative and quantitative work. Economic Geology is taught in a thorough manner and applied by courses in refractory materials and general metallurgy which contain problems depending upon the composition and impurities of ores and gangues; and by a course in prospecting which treats of the presentation of ores and gangues at the surface and the rules for their discovery.

The courses in general Metallurgy and Hydraulics are of indirect scientific value to the geologist, since the first renders him familiar with the composition, behavior, and fluidity of slags, as well as with blast furnace reactions, and the course in hydraulics develops the principles of moving fluids with their practical applications and serves as an introduction to the subject of geologic dynamics.

Beginning in the first term Junior year the student is given the choice of making the course a purely scientific one, or one embracing a little more technical work, assaying and mining engineering being made an alternative option with field work in geology.

The student who completes this course will receive the degree of Bachelor of Science (in Geology).

THE COURSE IN GEOLOGY.

FRESHMAN YEAR.

FIRST TERM.		SECOND TERM.	
Algebra and Trig., (4)	76, 77	Elementary Mechanics, (5)	80
Chemistry, (2)	227	Physics, (2)	187
Chemical Laboratory, (2)	228	Physical Laboratory, (1)	188
French, (3) *or* German, (3)	51 41	Land Surveying, (1)	89
Freehand Drawing, (2)	86	German, (3) *or* French, (3)	52 42
Mechanical Drawing, (2)	150	Qualitative Analysis, (3)	230
Hygiene, (1)	179	Stoichiometry, (2)	231
English, (3)	61, 62, 67	English, (3)	63, 64, 67

SUMMER TERM.

Land Surveying, 90.

SOPHOMORE YEAR.

FIRST TERM.		SECOND TERM.	
Analytic Geometry, (5)	81	Calculus, (5)	82
Physics, (3)	189	Physics, (3)	192
Physical Laboratory, (1)	191	Physical Laboratory, (1)	193
Crystallography, (2)	145	Mineralogy, (3)	146
Chem. Philosophy, (3)	232	Blowpipe Analysis, (1)	147
Quantitative Analysis, (2)	234	Petrology, (2)	162
German, (2) *or* French, (2)	53 / 43	Quantitative Analysis, (2)	243
English, (2)	65, 68	English, (2)	66, 68

SUMMER TERM.

Topographic Surveying, 91

JUNIOR YEAR.

FIRST TERM.		SECOND TERM.	
Geology, (2)	166	Geology, (2)	167
Botany, (1)	175	Petrology, (2)	164
Biology, (3)	177	Quantitative Analysis, (2)	238
Petrology, (2)	163	Field Geology, (3) *or* Mining Engineer'g, (3)	172 / 180
Blowpipe Analysis, (1)	148	Metallurgy, (5)	153
Zoölogy, (3)	176	Economics, (1)	7
Field Geology, (3) *or* Assaying, (3)	171 / 250	French, (2) *or* German, (2)	40 / 50
Economics, (1)	6		
French, (2) *or* German, (2)	39 / 49		
English, (1)	69		

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Geology, (4)	168	Mine Surveying, (2)	184
Economic Geology, (2)	169	Hydraulics, (3)	111
Physiography, (3)	170	French, (2) *or* German, (2)	42 / 52
Descrip. Astronomy, (3)	84	Philosophy of Religion, (1)	5
French, (2) *or* German, (2)	41 / 51	Thesis,	178
Geodetic Surveying, (3)	93	OPTIONS.	
		Pennsylvania Geology, (5) *or*	174
		Geological Surveying, (2)	173
		Pennsylvania Geology, (3)	174

The figures in parentheses indicate the number of exercises per week.

THE COURSE IN PHYSICS.

This course is designed to meet the requirements of the student who wishes to prepare for the teaching of Physics, or who wishes to pursue a graduate course of study in this science. The requirements for entrance to this course are the same as the requirements for entrance to the School of Technology.

As far as possible the same electives are offered during the Junior and Senior years. The available electives of the second term depend, however, upon the work which has been done during the first term. Thus, second term American History is open only to those who have taken first term American History; second term Politics is open only to those who have taken first term Politics; second term Psychology is open only to those who have taken first term Psychology; Mineralogy is open only to those who have taken Crystallography; and Practical Astronomy is open only to those who have taken Descriptive Astronomy. The character and scope of these elective studies and of the various required studies in the course, are described in the List of Studies on pages 35 to 65.

The History of Physics given during the second term of the Sophomore year is based on Poggendorff's "Geschichte der Physik" (in German), and is supplemented by encyclopedia articles.

The Theory of Light given during the first term of the Senior year is based upon Preston's "Theory of Light."

The Theory of Heat given during the second term of the Senior year is based upon Clausius's "Theory of Heat."

The seminary work of the Senior year consists of the participation in the work of the Physical Seminary which meets on alternate Tuesday evenings for the discussion of current literature in Physics. The membership of this seminary is made up of the corps of instructors of the department of Physics and Electrical Engineering together with graduate students and senior students taking the course in Physics.

Opportunities for graduate study leading to the degree of Master of Science, are offered by the Department of Physics and Electrical Engineering in the following subjects: The Theory of Alternating Currents, Experimental Researches in Electrical Engineering, Theoretical Physics, and Physical Research.

THE COURSE IN PHYSICS.

FRESHMAN YEAR.

FIRST TERM.

Algebra and Trig., (4) 76, 77
Chemistry, (2) 227
Chem. Laboratory, (2) 228
German, (3) *or* French, (3) 51 / 41
Freehand Drawing, (2) 86
Hygiene, (1) 179
English, (3) 61, 62, 67

SECOND TERM.

Elementary Mechanics, (5) 80
Physics, (2) 187
Physical Laboratory, (1) 188
Qualitative Analysis, 230
Stoichiometry, (2) 231
German, (3) *or* French, (3) 42 / 52
English, (3) 63, 64, 67

SOPHOMORE YEAR.

FIRST TERM.

Analytic Geometry, (5) 81
Physics, (3) 189
Physical Laboratory, (1) 191
Chem. Philosophy, (3) 232
French, (2) *or* German, (2) 39 / 49
English, (2) 65, 68

SECOND TERM.

Calculus, (5) 82
Physics, (3) 192
Physical Laboratory, (1) 193
History of Physics, (4) 197
French, (2) *or* German, (2) 40 / 50
English, (2) 66, 68

JUNIOR YEAR.

FIRST TERM.

Analytic Mechanics, (2) 83
Elec'y and Magnet'm, (2) 194
Dynamos and Motors, (2) 204
Elec. Laboratory, (2) 195, 196
French, (2) *or* German, (2) 41 / 51
Economics, (1) 6
English, (1) 69

OPTIONS, FOUR OR SIX HOURS.

American History, (2) 17
Economic History, (2) 8
Psychology, (2) 1
Politics, (1) 10
Crystallography, (2) 145
Organic Chemistry, (4) 246
Strength of Materials, (4) 98
Descrip. Astronomy, (3) 84

SECOND TERM.

Alternating Currents, (2) 206
Dynamo Laboratory, (2) 223
French, (2) *or* German, (2) 42 / 52
Economics, (1) 7

OPTIONS, TEN HOURS.

American History, (2) 16 *or* 18
European History, (2) 15
Politics, (1) 11
Psychology, (2) 2
Projection Drawing, (3) 87
Perspective, (3) 107
Hydraulics, (3) 111
Mineralogy, (3) 146
Metallurgy, (5) 153
Practical Astronomy, (2) 85

SENIOR YEAR.

FIRST TERM.		SECOND TERM.	
Theory of Light, (5)	198	Theory of Heat, (4)	199
Physical Laboratory, (2)	200	Physical Seminary, (2)	201
Physical Seminary, (2)	201	Thesis, (3)	202
OPTIONS, EIGHT HOURS.		OPTIONS, EIGHT HOURS.	
American History, (2)	17	American History, (2)	16 *or* 18
Economic History, (2)	8	European History, (2)	15
Psychology, (2)	1	Politics, (1)	11 *or* 13
Politics, (1)	10 *or* 12	Psychology, (2)	2
Crystallography, (2)	145	Projection Drawing, (3)	87
Organic Chemistry, (4)	246	Perspective, (3)	107
Strength of Materials, (4)	98	Hydraulics, (3)	111
Descrip. Astronomy, (3)	84	Mineralogy, (3)	146
Lithology, (2)	152	Geology, (3)	165
		Metallurgy, (5)	153
		Practical Astronomy, (2)	85

The figures in parentheses indicate the number of exercises per week.

GRADUATING THESES.

Every student is required to present a thesis upon some topic connected with the course from which he is to graduate, as a necessary portion of the exercises for his final examination for a diploma. These theses are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the Faculty.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

THE UNIVERSITY MUSEUMS.

The University Museums include large collections illustrating all branches of Industrial Chemistry, Metallurgy, Geology, Zoölogy, and Archæology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Paleontological, Mineralogical, Petrographic, and Economic collections. The first contains good specimens of nearly all the common genera. The Mineralogical division includes the Keim and Roepper collections—the latter being especially complete and valuable from a crystallographic standpoint. The Petrographic division numbers several thousand specimens and, besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and given by Dr. James P. Kimball, ex-Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

UNIVERSITY LECTURES.

From time to time during the University year, distinguished members of the various professions are invited to lecture before the student-body upon those special subjects to which they have given particular attention and upon which they are authorities.

The following lectures were given in this course during the year 1899-1900:

Dr. Josiah Strong, "New Social and Industrial Conditions Confronting the New Century."

Dr. W. H. Tolman, "Practical Philanthropy in New York."

Dr. Josiah Strong, "Religious Movements for Social Betterment."

Dr. W. I. Hull, "Social Aspects of the Saloon."

Mr. J. B. Reynolds, "The Social Settlement."

Dr. W. H. Tolman, "Social Engineering—A New Profession."

Mr. F. H. Newell, "The Storage Reservoirs of the Gila River, Arizona."

Prof. J. T. Rothrock, "The Relation of the Forests of Pennsylvania to the Interests of the State."

Miss Jane Addams, "The Subtle Problems of Charity."

Prof. B. F. Fernow, "The Evolution of the Forest."

Hon. Clinton Rogers Woodruff, "The Complexity of American Governmental Methods."

Prof. Lindley M. Keasbey, "The Political Aspects of Inter-Oceanic Transit."

Prof. Roland B. Falkner, "The Money Question in 1896 and in 1900."

Prof. John Bach McMaster, "Political Methods in the United States a Century Ago."

No public lectures were delivered during the year 1900-1901 owing to the loss of the large assembly hall by fire.

THE CHEMICAL AND NATURAL HISTORY SOCIETY OF LEHIGH UNIVERSITY.

This Society was organized in the fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of botanical and zoölogical specimens belonging to the Society are important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

THE ENGINEERING SOCIETIES.

The original Engineering Society was organized in 1873 and was open to all technical students of the University. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society," containing contributions by the members, alumni, and others. Many of the papers read before this Society from 1890 to 1893 were published in "The Lehigh Quarterly."

Recently the Civil Engineering and Mechanical Engineering sections have formed independent societies, with monthly meetings for the reading and discussion of papers relating to engineering subjects of their particular departments.

THE ELECTRICAL ENGINEERING SOCIETY.

This Society was organized in 1887. Its object is to supplement the regular work in Electrical Engineering by the discussion of current topics in electricity and by lectures given under the auspices of the Society by engineers and by members of the corps of instructors in the department of Electrical Engineering.

THE FORUM.

The Forum, a literary and debating society which meets semi-monthly, was organized in 1897. This Society has proved of great advantage to its members in the development of concise and logical thinking, in the promotion of ease before an audience, and in the acquirement of experience in parliamentary methods. Through this Society the University is represented in the Pennsylvania Intercollegiate Oratorical Union. An annual contest in debate is held with representatives of the literary societies of several other colleges. The Forum has justified its existence by the great increase in the amount of attention given, not only to training in oratory and debate, but also to those subjects of the day which are constantly discussed at its meetings.

THE MATHEMATICAL CLUB.

This Club was organized in February, 1895. Its members are students in the Junior and Senior classes. Its object is to continue the study of higher mathematics after having completed the mathematical course of the University. It holds frequent meetings, at which papers are read and discussed by its members.

THE ECONOMIC SOCIETY.

This Society meets on the second and fourth Tuesday of each month of the college year. Under the direction of the Professor of Economics the Society serves as a training place for the students of the upper classes for the discussion and application of economic principles to current questions.

THE LEHIGH UNIVERSITY CHRISTIAN ASSOCIATION.

This is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It

was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers being chosen from the student-body.

FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University. On Thursday, October 10, 1901, the twenty-second Founder's Day was celebrated. An address was delivered by Austin Scott, Ph.D., LL.D., President of Rutgers College, New Brunswick, N.J. His subject was "The Purposes of Our Citizenship."

At these exercises there was presented to the University a portrait, by Mlle. Marie Constantin, of Robert Alexander Lamberton, LL.D., President of the University from 1880 to 1893. The address of presentation was made by the Hon. Wayne MacVeagh, of Washington, D.C.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day. The Rev. George R. Van de Water, D.D., Rector of St. Andrew's Church, New York, N. Y., was the preacher on Sunday, June 16, 1901, in the Packer Memorial Church.

THESES.

Theses on the following subjects were prepared by candidates for degrees in 1901.

FOR THE DEGREE OF MASTER OF ARTS.

HENRY M. S. CRESSMAN, B.A., Egg Harbor City, N.J.
The Development of the German Drama.

FOR THE DEGREE OF MASTER OF SCIENCE.

PERCY LAWRENCE REED, C.E., New Bedford, Mass.
The Abolition of Railroad Grade Crossings in the United States, Particularly in Massachusetts.

WINTER LINCOLN WILSON, C.E., Bethlehem.
A Study of Virtual Profiles on the Lehigh and New Jersey Divisions of the Lehigh Valley Railroad for Freight Trains Running Eastward.

FOR THE DEGREE OF BACHELOR OF ARTS.

DAVID BEAN CLARK, Richlandtown.
Socialism: Its Modern Meaning.

PERCY LAMAR GRUBB, Harrisburg.
The Romance and Saxon Elements in Chaucer's "Prologue."

FOR THE DEGREE OF CIVIL ENGINEER.

CHARLES ENZIAN, Weissport.
Analyses of Sands of the Lehigh Valley and a Comparison of their Efficiencies for Water Filtration.

ERNESTO FRANCO, Quito, Ecuador.
Designs and Comparative Estimates for Stand Pipes and Trestle Tanks 150 Feet High.

WEBSTER NEUGARD HAAS, Hepler.
Design for a Bridge Connecting Bethlehem and South Bethlehem, Pa.

FREDERICK APPLE HAUSMAN, Allentown.
Review of the Water Supply System of Allentown, Pa., with Plans for its Extension.

LOUIS GUSTAVE KRAUSE, Absecon, N.J.
Plan and Estimate for a Sewerage System for West Bethlehem, Pa.

CHARLES JOSEPH MCGONIGLE, Allentown.
Plan and Estimate for Sewers and a Sewage Filtration Plant for Allentown, Pa.

CONRADO EUGENIO MARTINEZ, Habana, Cuba.
Engineering Literature and Technical Education in Cuba.

LUTHER DWIGHT MENOUGH, York.
Plan and Estimate for a Sewerage System for York, Pa.

WALTER HENRY RODNEY, Fort Riley, Kas.
The Strength and Weathering Qualities of Roofing Slate.

HERBERT SPENCER STAUFFER, South Bethlehem.
Plan and Estimate for a Filter Plant for the Water Supply of South Bethlehem, Pa.

GRANDISON GRIDLEY UNDERHILL, East Aurora, N.Y.
Determination of the Errors of the Weighing Apparatus of Two Testing Machines.

TUCK CHING STRONG YEN, Shanghai, China.
Design for a Steel Bell Tower to Replace the Wooden one in Shanghai, China.

ARTHUR REUBEN YOUNG, West Bethlehem.
The Investigation and Design of Cantilever Conveyor Cranes.

FOR THE DEGREE OF MECHANICAL ENGINEER.

JOAQUIM GREGORIANO DE ANDRADE, Manáos, Brazil.
Design of a Tugboat for the Amazon River.

CHARLES ELMER BARBA, Allentown.
The Adoption of Jigs in Machine Shops as a Labor Saving Device.

TIMOTHY BURNS, Yankton, S. D.
Fallacies Involved in Poleforcia, Recent Invention of B. C. Pole.

FRANCIS DONALDSON, Baltimore, Md.
Design of an Incline and Electric Tramway for a Coal Mine.

WILLIAM ALBERT EHLERS, Hernwood, Md.
Plans and Estimate for the Construction and Equipment of a 1000 K. W. Railway Power Station.

CADWALLADER EVANS, JR., Pittsburg.
Design of a Compressed Air Plant.

THOMAS MERCER GIRDLER, Jeffersonville, Ind.
A Comparison of Piece Work Systems.

SAMUEL THOMAS HARLEMAN, South Bethlehem.
Locomotive Coaling Stations. Design of a 600 Ton Coaling Station for the Lehigh Valley Railroad at South Easton, Pa.

EDMUND PERCIVAL JUMP, Easton, Md.
The Use of Blast Furnace Gas as a Motive Power.

SAMUEL TOWNSEND LAUBACH, Northampton.
Design of a 75 ft. Rotary Kiln for the Calcination of Portland Cement.

ALBERT RAYMOND LAUBENSTEIN, Ashland.
Test of the Manufacturing Plant of A. L. Laubenstein, Ashland, Pa.

OWEN FRANCIS LUCKENBACH, Bethlehem.
Design of a Slotting Head for the Screw Box of a 5-inch U. S. Army Gun.

EDWARD THOMAS MURPHY, Brooklyn, N. Y.
Compressed Air as a Factor in Rapid Transit.

JOHN JOSEPH NOLAN, Carbondale.
Design of a Bevel Gear Planer.

EVERETT JOHNSON PECK, Plainfield, N. J.
Rock Drills.

FERDINAND N. ROEBLING, JR., Trenton, N.J.
Plans for the Haulage of Ore from Friedensville to the Lehigh Valley Railroad.

JOHN WALLACE SHAEFFER, Fleetwood.
Duty Test of the Marden Creek Pumping Plant, Berkley, Pa.

JOHN FIFE SYMINGTON, Baltimore, Md.
Tool Steel.

HENRY DALZELL WILSON, Pittsburg.
Design and Discussion of a Tower Condenser.

FOR THE DEGREE OF METALLURGICAL ENGINEER.

DAVID MAURICE BARRY, Agawam, Mass.
Investigation of Casting Machines at South Bethlehem and Hellertown, Pa.

MORRIS WILBUR GARMAN, (with H. J. Moore), Nanticoke.
Investigation of the Working of a Blast Furnace at Hellertown, Pa.

FOR THE DEGREE OF MINING ENGINEER.

SAMUEL RAY ALDER, (with E. T. Thornton), Redlands, Cal.
Manufacture of Spelter as Carried on by the New Jersey Zinc Company.

JOSEPH WILLIAM BURKE, B.S., (with A. Sanchez), Shenandoah.
Compressed Air Haulage at the Anthracite Collieries.

JOHN HENRY CRANE, (with W. W. Graff), Chicago, Ill.
Study for the Utilization of Blast Furnace Waste Gases Directly in Gas Engines at the Blast Furnaces of the Bethlehem Steel Company.

WILBUR WILSON GRAFF, (with J. H. Crane), Rushville, Ill.
Study for the Utilization of Blast Furnace Waste Gases Directly in Gas Engines at the Blast Furnaces of the Bethlehem Steel Company.

JOHN GEORGE HEINZ, B.S., Louisville, Ky.
Forepoling in the Mammoth Bed at Hazleton, Pa.

HENRY JARVIS MOORE, (with M. W. Garman), Gill, Mass.
Investigation of the Working of a Blast Furnace at Hellertown, Pa.

ARMANDO SANCHEZ, B.S., (with J. W. Burke), Neuvitas, Cuba.
Compressed Air Haulage at the Anthracite Collieries.

EDWARD T. THORNTON, (with S. R. Alder), Philadelphia.
Manufacture of Spelter as Carried on by the New Jersey Zinc Company.

FOR THE DEGREE OF ELECTRICAL ENGINEER.

PAUL LEWIS ANDERSON, (with L. A. Freudenberger), Somerville, N. J.
Theory and Calculations of the Induction Motor.

JOHN HENRY FLORY, (with C. W. Startsman), Ashley.
Theory and Calculations of Alternating Current Transmission Lines.

LEWIS ALFRED FREUDENBERGER, (with P. L. Anderson), West Bethlehem.
Theory and Calculations of the Induction Motor.

HOWARD MAIN GASSMAN, Hagerstown, Md.
The Design of Motor Starting Rheostats.

ELWOOD SCOTT HARRAR, (with G. W. Welsh), Allentown.
Conductivity Tests of Copper.

JAMES C. RYAN, (with W. D. Cassin), Harrisburg.
Induction Wattmeter Tests.

ALBERT CLINTON SAVIDGE, (with J. S. Van Alen), Sunbury.
Resistance Standards.

CHARLES W. STARTSMAN, B.S., (with J. H. Flory), Iowa City, Ia.
Theory and Calculations of Alternating Current Transmission Lines.

JAMES STRAWBRIDGE VAN ALEN, (with A. C. Savidge), Northumberland.
Resistance Standards.

GEORGE WILLIAM WELSH, (with E. S. Harrar), Hanover.
Conductivity Tests of Copper.

FOR THE DEGREE OF ANALYTICAL CHEMIST.

NEWTON WAYNE BUCH, Lancaster.
On the Action of Sulphuric Acid on Iso-propyl-phenyl Ether.

FRANK BENJAMIN GEARHART, Altoona.
Molybdenum and Its Compounds: Their Preparation and Properties.

ALFREDO JORGE SANCHEZ, Matanzas, Cuba.
The Cultivation and Manufacture of Sugar in Cuba.

EDWIN BENTON WILKINSON, Williamsport.
On the Action of Sulphuric Acid on Iso-butyl-phenyl Ether.

UNIVERSITY DAY.

This day is the last of the academic year, and falls in 1902 on the third Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 19, 1901.

MUSIC.

PRAYER.

MUSIC.

Salutatory Oration.—"The Need of a National Conscience."
SAMUEL THOMAS HARLEMAN.

MUSIC.

Oration.—"Search for Truth."
DAVID BEAN CLARK.

Oration.—"The Seen and the Unseen."
HENRY JARVIS MOORE.

Oration.—"Culture Studies in a Technical Education."
EDWIN BENTON WILKINSON.

MUSIC.

Alumni Address.—"An American University."
PAUL MAYO PAINE, C.E.,
Class of 1891.

MUSIC.

Valedictory Oration.—"Our Colonial Policy."
LEWIS ALFRED FREUDENBERGER.

MUSIC.

Address to the Graduating Class,
BY THE REV. S. D. MCCONNELL, D.D., of Brooklyn.

Award of the Wilbur Scholarship to
PAUL T. KRAUSE, of Bethlehem.
First in rank in the Sophomore Class.

The Price Prize for English Composition, open to members of the Freshman Class, was awarded to
JACOB H. BRILLHART, of Loganville.

Prizes for Excellence in English Composition, open to members of the Sophomore Class, were awarded to

John Joseph Cort, of Latrobe.
Nicholas Hunter Heck, of Heckton Mills.
Vicente Saucedo, of Saltillo, Mexico.
Dyer Smith, of Washington, D. C.
Hiram Sanborn Chamberlain, jr., of Chattanooga, Tenn.
Chauncey Shackford Curtis, of New Castle.
Harvey Ernest Jordan, of Coopersburg.
George Rosebery Stull, of Ridley Park.

The Wilbur Prizes, for excellence in the studies of Freshman year, were awarded as follows:

In Mathematics, to

John Jacob Grabe, of Mitan, Russia, and
Oliver Jacob Haller, of Pittsburg.

In German to

Harold Patterson Reno, of Pittsburg.

In French, to

Frank G. Burrows, of Williamsport.

In English, to

Ralph Lucas Talley, of Williamsport.

In Freehand Drawing, to

Howard Green Bayles, of East Orange, N. J., and
Lester Bernstein, of Philadelphia.

In General Chemistry, to

Ellerslie Lawrence Feick, of Reading.

Prizes for Excellence in Declamation, open to members of the Freshman Class, were awarded to

Thomas Archie Morgan, of Scranton.
William Roland Johnston, of Washington, D. C.
Louis G. McCauley, of Susquehanna.

Degrees were then conferred by the President of the University upon the candidates whose names appear in the Thesis List, as given above.

THE WILBUR SCHOLARSHIP.

This scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP FUND.

By a resolution of the Alumni Association of September 21, 1900, this fund, which was originally designed to help poor students, has with the consent of the contributors been diverted from this purpose and the income will in the future be used for prizes to members of the Junior Class under such conditions as may be determined upon by the President of the University and the President of the Alumni Association. This change was made in accordance with the recommendation of the President of the University in view of the fact that in the President's Fund and the Coxe Memorial Fund there was now an abundant provision for loans of money to indigent students.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship of the annual value of $200, which is to be devoted to the support at Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS.

Friends of the late Frederick Mercur, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, have contributed and placed in the hands of the Trustees a fund, to be called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of five scholarships for free tuition in the University.

THE ECKLEY B. COXE MEMORIAL FUND.

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $28,000, the interest of which is to be used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of students who without such aid would not be able to meet the cost of living as students of the University.

THE FRANK WILLIAMS FUND.

Mr. Frank Williams, E.M., of Johnstown, Pa., a graduate of the course in Mining and Metallurgy of the Class of '87, who died October, 1900, bequeathed to the University the greater part of his estate to found a Fund, the income of which is to be loaned to deserving students. The bequest becomes available for this purpose in 1905.

WILBUR PRIZES.

By the generosity of E. P. Wilbur, Esq., a fund has been established, yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

THE PRICE PRIZE FOR ENGLISH COMPOSITION.

Dr. Henry R. Price, an Alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the department of English not later than the beginning of the Second Term in each year.

In estimating the value of all such essays the greatest stress will be laid upon clearness of thought and idiomatic force of expression; and, in the judgment of the examiner, while looking for correctness of thought in clear and forcible English, expression will take precedence of ideas. For this specific end, weight will be given to the form rather than to the matter presented.

Competitors must signify their intent not later than the first of April.

The subject for the prize essay in June, 1902, will be: "The Poems of Collins or Blake."

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of Lehigh University" established in 1882 an annual sum of $50, to be distributed in prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 22, 1901, with the following competitors:

William Smith Brownell, jr., of Newport, R. I.
James Nethermark Downey, of Lancaster.
Foster Hewett, of Colorado Springs, Colo.
Walter Scott Johns, jr., of Martindale.
Frederick Farrar Lines, of Bethlehem.
William Frank Roberts, of Freeland.

The First Prize was awarded to Frederick Farrar Lines; the Second to James Nethermark Downey; the Third to William Frank Roberts.

The judges were Mr. A. G. Rau, '88, of Bethlehem; Mr. J. W. Thurston, '96, of South Bethlehem, and Mr. C. A. Buck, '87, of South Bethlehem.

PRIZES IN ENGLISH AND ORATORY.

A friend of the University, who desires for the present to remain unknown, established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize," of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize," of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amounts of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered to that section. If more than one student shall receive the next highest rank in any section where there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

2. The Faculty shall publish within one month from the beginning of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty—when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously,

but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or their committee, shall meet on the above date and at subsequent adjourned meetings and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted, they shall declare the contest closed for that year, and no prizes shall be awarded; but the sum of one hundred and fifty dollars, which is in the hands of the President to pay for them, shall be used by him in such manner as he shall see fit to encourage public speaking in the University.

If one or more dissertations are admitted as aforesaid, the Faculty, or their committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or their committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

If fewer than six candidates shall present dissertations, or fewer than six dissertations shall be admitted to the contest, the whole, or such part of the sum of the above one hundred and fifty dollars as shall not be awarded at the close of the contest, and shall remain in the hands of the President, shall be used by him, as aforesaid, to further public speaking in the University, in any manner as he may see fit.

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence and taking postgraduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those which fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded. The sum of one hundred and twenty-five dollars in the hands of the President to pay this prize, in the event of its not being awarded, as aforesaid, shall be used by him to further public speaking, as aforesaid, unless, however, he may consider that he has already a sufficient fund in his hands for that purpose. In this latter case, he shall use this above sum of one hundred and twenty-five dollars to encourage public debate in the University in any manner that he may see fit.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University; but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

ENTRANCE EXAMINATION PAPERS.

USED FOR EXAMINATION IN 1901.

I.—ENGLISH.

1. What is Rhetoric? Explain present use of words. National use. Reputable use. Give rule of Precision; Simplicity; Euphony.

2. What is a Barbarism? An Impropriety? A Solecism? Discuss barbarisms in detail.

3. Construct a table showing the correct use of *shall* and *will*. What is the distinction between an emphatic pronoun and a reflexive pronoun? The proper use of *either*, *can* and *may?* The proper position of adverb with infinitive?

4. How may choice of words affect Clearness? Force? Ease? Is Clearness a relative or an absolute quality of style? Difference between Clearness and Precision?

5. What are Tropes? Name and define the kinds of tropes. Advantages of the use of tropes? Danger of misuse?

6. How may Force and Ease be affected by the number of words used? Define Redundancy. Name and define the divisions of redundancy.

7. How does arrangement of words affect Force? What is Antithesis? Climax? Meaning and value of Unity? How violated?

8. Give examples of the periodic sentence; the loose sentence; the balanced sentence. Mention the advantages in the use of each kind. State the subject matter and purpose of each of the four kinds of composition.

9. Discuss completely Description, Narration or Exposition.

10. Write a theme of about 200 words on a subject of your own selection, suggested by any of the Required Readings.

N. B.—A paper in English Grammar is set for students whose Rhetoric papers show grammatical errors.

II.—UNITED STATES HISTORY AND CONSTITUTION.

1. Draw an outline map of North America showing the extent of territory in 1750 possessed by the European States.

2. Give a brief account of the events which led to the establishment of British supremacy in North America.

3. What were the nationalities which went to form the New England group of settlements? The Middle States group? The Southern group?

4. (*a*) When and by whom was slavery introduced into the British American Colonies? (*b*) Was slavery ever in existence north of Mason and Dixon's line?

5. What were the principal features of the British colonial policy in the 18th century? In what way has that policy been modified?

6. Was there a central government for the United States during the period 1776-89? Where did it gets its authority?

7. What was the "Reconstruction Period" in the history of the Southern States?

8. Where does the Supreme Court get its power to declare acts of Congress unconstitutional?

9. Describe the constitutional method of choosing the President of the United States. Is the method prescribed in the Constitution actually followed?

10. What was the cause of the rise of the People's, or Populist Party? Contrast its principles with the Republican and Democratic parties.

III.—GEOMETRY.

1. Define (*a*) Geometrical Solid, Angle, Hypothesis, Postulate, Mean Proportion. (*b*) State various conditions which will cause two triangles to be similar; also conditions for equality.

2. Show what is the measure of an angle formed by intersecting chords, whether they intersect within or without the circle.

3. To divide a line into extreme and mean ratio: give proof.

4. If a line bisects any angle of a triangle show that it divides the opposite sides into segments proportional to the adjacent sides.

5. Find sum of squares of four sides of any quadilateral in terms of its diagonals.

6. The sum of the exterior angles of any polygon=what? Give proof.

7. (*a*) Name and define the regular polyedrons. (*b*) Define polar triangle, ratio of similitude, zone, symmetrical spherical triangles, cylindrical surface.

8. A given right circular cone has for radius of base 3 ft., altitude 4 ft. Find (*a*) Volume. (*b*) Total area. (*c*) Altitude of similar cone of half its volume.

9. What is the measure of the angle formed by the intersection of two arcs of great circles on any sphere? Give proof.

10. A triangular prism is equivalent to what? Give proof.

11. A line which is perpendicular to each of two lines of a plane at their point of intersection is perpendicular to the plane.

IV.—ALGEBRA.

1. Define prime factor, surd; when is a radical simple; imaginary; affected quadratic; what is general form of an affected quadratic?

2. (*a*) What will $x+y$ and $x-y$ divide? Why? (*b*) Derive formulas for geometrical progression.

3. Find $H\,C\,F$ and $L\,C\,M$ of $6x^3+7x^2-5x$ and $15x^4+31x^3+10x^2$.

4. Simplify $\dfrac{1}{x+\dfrac{1}{1+\dfrac{x+1}{3-x}}}$

5. (*a*) Expand $(2x^{\frac{1}{2}}-3y^{-2})^5$.

(*b*) Find cube root of $\dfrac{x^3}{a^3}-\dfrac{9x^2}{a^2}+\dfrac{33x}{a}-63+\dfrac{66a}{x}-\dfrac{36a^2}{x^2}+\dfrac{8a^3}{x^3}$.

6. Simplify (*a*) $2a\sqrt[3]{54a^2x^4}$, $4\sqrt{\dfrac{4a^4}{9b}}$.

(*b*) $\dfrac{\sqrt{x}+\sqrt{y}}{\sqrt{x}-\sqrt{y}}$; $\dfrac{2}{2\sqrt{7}+\sqrt{5}-\sqrt{3}}$. (*c*) $\dfrac{8^{-\frac{4}{3}}\div 9^{\frac{3}{2}}}{16^{\frac{3}{4}}\times\sqrt[3]{(27)^{-1}}}$.

7. Solve (*a*) $\sqrt{x+5}+\sqrt{x+16}=\sqrt{x+101}$. (*b*) $x^4-35x^2+216=0$.

8. Solve $2x+y=10$ and $2x^2-xy+3y^2=54$.

9. A cistern can be filled in 4 hours by two pipes running together, and in $6\frac{1}{4}$ hours by one alone. In how many hours can the other pipe fill it alone?

10. A square plot of ground has a 3 foot walk around it: The area of the walk lacks $\frac{1}{3}$ of a square yard of being $\frac{1}{3}$ the area of plot. Find area of plot.

V.—TRIGONOMETRY.

1. Construct two angles each less that 360° whose tangent is $-\frac{3}{4}$ and find values of other trigonometric functions of these angles.

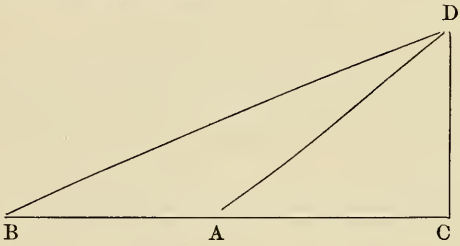
2. Prove $sin\ (270° \pm A) = -\ cos\ A$.

3. Prove $sin\ 3x = 3\ sin\ x - 4\ sin^3 x$.

4. Prove $cos\ \frac{1}{2}A = \sqrt{\frac{sin\ s\ sin\ (s-a)}{sin\ b\ sin\ c}}$

5. The side of a regular decagon is 2.4304 feet. Find the radii of inscribed and circumscribed circles.

6.



Given: $AB = 4163.2$, $DBA = 28° 50' 24''$, $DAC = 40° 28' 36''$. Find DA, DB, DC, AC.

VI.—PHYSICS.

1. A stick of uniform sectional area floats vertically in a vessel of water with $\frac{2}{3}$ of its length submerged. It floats with $\frac{1}{2}$ of its length submerged when placed in a vessel of brine. What is the Specific Gravity of the brine? Explain.

2. A glass vessel weighs 65.4 grams when empty and 367.2 grams when filled with water at 21° C at which temperature the density of water is 0.998 grams per cubic centimeter. What is the volume of the vessel? Explain your arithmetical work.

3. In an ordinary platform scale a weight of one pound hangs on the scale beam at a distance of 12 inches from the fulcrum of the beam. A vertical rod is attached to the beam at a distance

of 1 inch from the fulcrum, on the side opposite to the 1 pound weight. This rod attaches to a lever under the platform. This lever supports the platform at a point distant 1½ inches from its fulcrum and the above mentioned vertical rod attaches to this lever at a distance of 24 inches from the fulcrum. How many pounds on the platform are balanced by the one pound weight? Give a sketch of the arrangement as described above and explain your solution.

4. A spiral spring is elongated 1½ inches by a stretching force of 10 pounds, what additional elongation will be produced by an additional force of 10 pounds? What total elongation will be produced by a total stretching force of 30 pounds?

5. A steam engine has a cylinder 10 inches in diameter, its length of stroke is 12 inches, its speed is 120 revolutions per minute, and the average steam pressure in the cylinder is 50 pounds per square inch. What is the horse-power that is developed by the engine?

6. Describe an experiment showing that a piece of metal increases in dimensions with rise of temperature. Describe the process known among machinists as the shrinking of a collar on a shaft.

7. Reduce 80° F to C. Reduce 90° C to F.

8. What is meant by *relative humidity* of the atmosphere? What is meant by the *dew point?* What is meant by the *pressure of the aqueous vapor* in the atmosphere?

9. Describe the magnetic effect of the electric current; that is, describe the action of a wire-carrying-current upon a magnet, and describe the action of the magnet upon the wire; wire and magnet being both stationary.

10. The essential parts of a telescope are *object glass* and *eye-piece.* Explain the function of each.

11. When a vowel sound is sung loudly near a piano of which all the strings are free to vibrate the vowel is heard very distinctly to issue from the piano after the voice has ceased. Explain.

12. What is meant by a *node* on a vibrating string? By an *antinode?* What is a node in a long vibrating air column such as the air column in an organ pipe? What is an antinode in such a vibrating air column? How does the air move on opposite sides of a node in an organ pipe? What changes take place at the node?

13. An assortment of colored worsteds are illuminated by light from a sodium flame (containing, practically, light of one wavelength only). Describe the appearance of the worsteds and explain. Why do brilliant colors appear to better advantage in day light than in lamp light? What is the peculiarity of lamp light which causes this difference?

VII.—GERMAN.

1. Decline in singular and plural: his old book, good wine, the boy.

2. How are the auxiliaries of tense used in German? Give sentences containing examples.

3. Decline the personal pronouns in full.

4. Give five subordinating conjunctions and their meanings.

5. Give the third person singular active and passive voice of *abschreiben* all moods and tenses.

6. Give the principal parts and meanings of *hauen, raten, werfen, laufen, schneiden, gehen.*

Translate into German:

1. The boys we met yesterday have been compelled to remain at home today.

2. I should have come if I had known it.

3. He was reading when I came into the room.

5. He died on the 22nd of March, 1898, at four o'clock in the morning.

5. At what time does the train leave for Boston?

6. He translated the letter which I copied.

7. I was compelled to give him the money.

8. (*a*) I am dizzy. (*b*) He is sorry. (*c*) You are right.

Jetzt hatte er in der Schule ein neues Interresse: er hatte auf weissen Karten schöne Tiere abgebildet gesehen, welche die Kinder der oberen Klassen nachzeichneten. Schnell probierte er das auch mit seinem Bleistift[1] und daheim fuhr er dann fort, die Tiere wieder und wieder zu zeichnen, so lange er noch ein Stückchen Papier hatte. Dann schnitt er die Tiere aus und wollte sie auf den Tisch stellen, aber das ging nicht. Da kam er plötzlich auf den Gedanken, dass wenn sie von Holz wären, sie gewiss stehen könnten. Er fing schnell an, mit seinem Messer an einem Holzstückchen herumzuschneiden, bis ein Leib und vier Beine da waren; aber zu einem Hals und dem Kopf

darauf reichte das Holz nicht, er musste ein anderes Stück nehmen und von Anfang an berechnen, wie hoch es sein und wo der Kopf sitzen müsse. So schnitzte der Toni immer zu, bis er etwas wie ein Tier zurechtgebracht hatte und es nun mit grosser Freude der Mutter zeigen konnte. Sie war sehr erfreut und sagte: Du wirst gewiss einmal ein Holzschnitzler[2] und ein recht guter. Von der Zeit an schaute Toni alle Stückchen Holz, die auf seinen Weg kamen, darauf an, ob sie gut zum Schnitzen wären, und fand er das, so packte er sie schnell ein, so dass er manchmal alle Taschen voller Holzstücke heimbrachte und diese in jeder freien Minute wieder zu schnitzen anfing.

1. Lead pencil. 2. Wood Carver.

Die heisse Julisonne schien durch die Fenster der Schule auf unsere Köpfe und wir schwitzten dicke Angsttropfen über der Grammatik, während die Vögel draussen in den Bäumen uns auslachten, und die Fliege, die frei über das blaue Heft spazierte, uns ein glückliches Tier schien! Nun ist es schon Winter, Schnee liegt auf dem Boden und den Dächern und wird vom freien lustigen Wind gegen die Fenster gewirbelt[1]. Der Wind und die tanzenden Schneeflocken lachen uns nicht weniger aus, als die Sommervögel und die Fliegen; es macht uns nur ein kleines Vergnügen, dass wir nach Herzenslust den Cornelius Nepos lesen dürfen. Eine ganz andere Befriedigung würde es uns gewähren, wenn wir dem alten Römer draussen auf dem Marktplatz das Herzeleid, welches er über so manche Generationen von Schulbuben gebracht hat, durch einen tüchtigen Hagel[2] von Schneeballen zurückzahlen könnten! Wir werden in der zweiten Klasse mit "Sie" angeredet; weit in der Ferne liegt jene Zeit, wo wir selbst des Nachts in unsern Träumen nicht vor dem Stocke des Lehrers sicher waren; wir haben unter den Folgen der ersten Cigarre gelitten; einige von uns haben sogar Brillen[3] von Fensterglas aufgesetzt; wir fangen an, vor den Fenstern der ersten Klasse der Mädchenschule Parade zu machen. O selige Jugendzeit!

1. To whirl. 2. Hail. 3. Spectacles.

VIII.—FRENCH.

1. When is the subjunctive mood used in French? Give sentences illustrating its use.

2. Distinguish between *qui* and *que* used as relative and interrogative pronouns.

3. Compare the adjectives *bon, mauvais, peu.* Form the plural of *oeil, ciel, cheval, hibou.*

4. Write the singular, the present indicative of *valoir, aller, voir, lire.* The future of *craindre, voir, tenir.*

5. Give the principal parts of *devoir, boire, mouvoir, naitre, pouvoir, vivre.*

Translate into French:

1. The lady we saw in the city has returned home.

2. Did you find the books you were looking for?

3. Although they were in Paris three days they were not happy there.

4. We had some books yesterday but we will not have any to-morrow.

5. This house is larger than my father's.

6. Give it to them, do not give it to him.

7. (*a*) It is worth nothing (*b*) It is fine weather (*c*) He is hungry (*d*) It is I.

Translate into English:

Il avait distribué une partie de ses dépêches, mais sa tournée était loin d'être terminée, lorsqu' il passa devant une auberge, ou plutôt un misérable cabaret[1] qui s'élevait a l'entrée d'un bois; cette maison avait pour principale clientèle les sabotiers[2] qui y trouvaient quelques articles d'épicerie et des boissons alcooliques.

Hola! monsieur le facteur[3] arrêtez-vous donc un instant ici; en me donnant des renseignements dont j'ai besoin, vous laisserez passer l'orage.

Cette invitation lui était adressée par un homme qui, la pipe á la bouche, se tenait sur le seuil du cabaret.

La pluie faisait rage[4] en ce moment; un vent violent la fouettait au visage du père Martin qu' il empêchait de marcher, et inclinait vers la terre les plus gros arbes.

Le facteur était un peu en avance, et les exigences du service ne vont pas jusqu'à interdire d'accepter un abri momentané, quand il s'offre dans de pareilles circonstances.

In pénétra donc dans la maison et alla s'installer, auprès du feu qui pétillait[5] dans la cheminée. Celui qui l'avait invité à entrer, y jeta quelques branches sèches qui ne tardèrent pas à flamber; une épaisse vapeur ze dégagen des vêtements.

1. tavern. 2. makers of wooden shoes. 3. postman. 4. raged. 5. to crackle

L'autre l'interrogea sur les heures de départ des courriers, lui adressa une foule de questions sur lui-même, sur son service, sur tout ce qui le concernait.

Vous me connaissez donc? dit le facteur.

Parbleu! Tout le monde vous aime et vous estime ici: on sait ce que vaut le père Martin.

Translate into English:

Le roi d'Angleterre fit son entrée en grande pompe à Douvres, puis à Londres. Il avait mandé ses frères; il avait amené sa mère et sa soeur. L'Angleterre était depuis si longtemps livrée à elle-même, c'est-à-dire à la tyrannie, à la médiocrité et à la déraison, que ce retour du roi Charles II, que les Anglais ne connaissaient cependant que comme le fils d'un homme auquel ils avaient coupé la tête, fut une fête pour les trois royaumes. Aussi, tous ces voeux, toutes ces acclamations qui accompagnaient son retour, frappèrent tellement le jeune roi, qu'il se pencha à l'oreille de Jack d'Yorck, son jeune frère, pour lui dire:

En vérité, Jack, il me semble que c'est bien notre faute si nous avons été si longtemps absents d'un pays où l'on nous aime tant.

Le cortège fut magnifique. Un admirable temps favorisait la solennité. Charles avait repris toute sa jeunnesse, toute sa belle humeur; il semblait transfiguré; les coeurs lui riaient comme le soleil.

LATIN.

I. Grammar.

[In writing Latin words of more than two syllables mark the quantity of the penult.]

1. Decline *Lucius Sulla, Aeneas, deus, lacus, os* (a bone), *os* (the mouth), *tu, is, felix.* Give the rules for determining the gender of nouns.

2. What words are declined like *alius* and what is their peculiarity?

3. Form adverbs from the following adjectives and then compare them: *fortis, altus.* Compare *parvus, aeger.*

4. Write in Latin 1901.

5. Give the present indicative of *nolo, possum, eo.*

6. Explain the formation of the different parts of the active voice of the verb and give the scheme of endings.

7. What are the principal parts of *soleo, tono, vicerunt.*

8. Give the first person of each tense of *audio* in the passive.

9. State the rules for the use of moods and tenses in the indirect discourse.

10. Mention the various ways of expressing purpose, with examples.

III. Caesar.

Translate (*Bk. II, 11*):—

Ea re constituta, secunda vigilia magno cum strepitu ac tumultu castris egressi, nullo certo ordine neque imperio, cum sibi quisque primum itineris locum peteret et domum pervenire properaret, fecerunt ut consimilis fugae profectio videretur. Hac re statim Caesar per speculatores cognita, insidias veritus, quod qua de causa discederent nondum perspexerat, exercitum equitatumque castris continuit. Prima luce, confirmata re ab exploratoribus, omnem equitatum qui novissimum agmen moraretur praemisit.

What time is meant by *secunda vigilia?* Give construction of *fugae, domum, moraretur.*

Translate (*Bk. IV, 19*):—

Caesar, paucos dies in eorum finibus moratus, omnibus vicis aedificiisque incensis, frumentisque succisis, se in fines Ubiorum recipit; atque iis auxilium suum pollicitus, si ab Suevis premerentur, haec ab iis cognovit: 'Suevos, posteaquam per exploratores pontem fieri comperissent, more suo concilio habito, nuntios in omnes partes dimisisse, uti de oppidis remigrarent, liberos, uxores, suaque omnia in silvis deponerent, atque omnes, qui arma ferre possent unum in locum convenirent.'

Change the speech to direct discourse.

III. Cicero.

Translate (*Cat. I,* §27):—

Etenim si mecum patria, quae mihi vita mea multo est carior, si cuncta Italia, si omnis res publica, loquatur: 'M. Tulli, quid agis? Tune eum, quem esse hostem comperisti, quem ducem belli futurum vides, quem exspectari imperatorem in castris hostium sentis, auctorem sceleris, principem conjurationis, evocatorem servorum et civium perditorum, exire patiere, ut abs te non emissus ex urbe, sed immissus in urbem esse videatur?'

Explain the construction of the subjunctives in the passage. Give the abbreviations of such praenomina as you recall.

Translate (*Cat. III*, §*10*) :—

Ac ne longum sit, Quirites, tabellas proferri jussimus, quae a quoque dicebantur datae. Primum ostendimus Cethego signum: cognovit. Nos linum incidmus: legimus. Erat scriptum ipsius manu Allobrogum senatui et populo sese quae eorum legatis confirmasset facturum esse; orare ut item illi facerent quae sibi eorum legati recepissent.

How were Roman letters written and secured? Where did the Allobroges dwell? Give syntax of *orare* and *sibi*.

Translate (*Archias*, §*22*) :—

Carus fuit Africano superiori noster Ennius, itaque etiam in sepulcro Scipionum putatur is esse constitutus ex marmore. At eis laudibus certe non solum ipse qui laudatur, sed etiam populi Romani nomen ornatur. In caelum hujus proavus Cato tollitur: magnus honos populi Romani rebus adjungitur. Omnes denique illi Maximi, Marcelli, Fulvii, non sine communi omnium nostrum laude decorantur.

Translate (*Manilian Law*, §27) :—

Utinam, Quirites, vivorum fortium atque innocentium copiam tantam haberetis, ut haec vobis deliberatio difficilis esset, quemnam potissimum tantis rebus ac tanto bello praeficiendum putaretis! Nunc vero—cum sit unus Cn. Pompeius, qui non modo eorum hominum qui nunc sunt gloriam, sed etiam antiquitatis memoriam virtute superarit—quae res est quae cujusquam animum in hac causa dubium facere possit?

State what classes the conjunctions in this passage belong under.

IV. Vergil.

Translate (*Aen. I, 664*) :—

'Nate, meae vires, mea magna potentia solus,
Nate, patris summi qui tela Typhoia temnis,
Ad te confugio et supplex tua numina posco.
Frater ut Aeneas pelago tuus omnia circum
Litora jactetur odiis Junonis iniquae,
Nota tibi, et nostro doluisti saepe dolore.'

When and by whom were these lines supposed to have been spoken? Give the full name of the meter of the first line.

Translate (*Aen. V, 104*):—

Expectata dies aderat, nonamque serena
Auroram Phaëthontis equi jam luce vehebant,
Famaque finitmos et clari nomen Acestae
Excierat! laeto complerant litora coetu,
Visuri Aeneadas, pars et certare parati.
Munera principio ante oculos circoque locantur
In medio, sacri tripodes viridesque coronae,
Et palmae pretium victoribus, armaque et ostro
Perfusae vestes, argenti aurique talenta;
Et tuba commissos medio canit aggere ludos.

What other form does *complerant* have? Write out the fifth and sixth lines of this passage, dividing them into feet, marking the quantity of each syllable and indicating the caesuras. What was the story of Phaëthon?

V. Latin at Sight.

Hae permanserunt aquae dies complures Conatus est Cæsar reficere pontes, sed nec magnitudo fluminis permittebat neque ad ripam disposĭtae cohortes adversariorum perfici patiebantur; quod illis prohibere erat facile cum ipsius fluminis natura atque aquae magnitudine, tum quod ex totis ripis in unum atque angustum locum tela jaciebantur; atque erat difficile eodem tempore rapidissimo flumine opera perficere et tela vitare.—*Caes. B. Civ. I, 50.*

VI. Latin Prose Composition.

Romulus, in order to increase (*augeo*) the number of the citizens, established (*patefacio*) an asylum (*asylum*) to which many who had been banished from their own cities (*civitas*) fled. But wives were lacking (*desum*) for the citizens of the new city. And so he instituted a festival (*festum*) and games to Neptune (*Neptunus*). When many from the neighboring peoples had come to these along with (*cum*) their wives and children, the Romans carried off (*rapio*) the maidens (*virgo*) while they were looking at the games. Those tribes (*populus*), whose maidens had been carried off, began (*suspicio*) war against (*adversus*) the captors (*raptor*).

VII. Roman History.

1. Tell the story of the War with Pyrrhus.
2. What were the main events in the life of Cicero?

3. Give an outline of the Second Punic War.

4. Who were the decemvirs, when did they live and what did they do?

5. What reforms did the Gracchi seek to bring about?

GREEK.

I. Grammar.

1. Write the following passage with proper accents and breathings;

ωετο δε αρκειν προς το αρχικον ειναι και δοκειν τον μεν καλως ποιουντα επαινειν, τον δε αδικουντα μη επαινειν. τοιγαρουν αυτῳ οι μεν καλοι τε καγαθοι των συνοντων ευνοι ησαν, οι δε αδικοι επεβουλευον ως ευμεταχειριστῳ οντι. οτε δε απεθνῃσκεν ην ετων ως τριακοντα.

2. Decline throughout *πολίτης, νοῦς, σώφρων* (both genders); through the singular, *μοῦσα, ὁδός, βοῦς, ἠχώ*; through the plural, *πόλις, εὐγενής* (both genders), *χαρίεις* (three genders).

3. Compare the adjectives *μικρός, πολύς, ἐχθρός*; the adverb *μάλα*.

4. Give the Greek words for *six, tenth, four times;* decline the words for *two, three.*

5. Give the principal parts of *αἱρέω, φέρω, τάττω*; the synopsis (*i.e.*, first form of each mode) of the aorist, active, middle, and passive, of *ἵημι*; the inflection through the numbers and persons of the perfect indicative middle of *πράττω*, and the imperfect indicative, active and middle, of *ὁράω*; the present participle, dative plural, of *τίθημι*.

6. Decline *τοιοῦτος*; translate *to us, of ourselves, which (of two)? how much? somewhere, when?*

7. Name three classes of verbs that govern the dative; five prepositions that govern both genitive and dative, giving their meaning with each case.

8. What is the meaning of the subjunctive when used in an independent sentence? of the optative?

9. *ἐὰν Κῦρος ἔλθῃ, αὐτὸν ὄψομαι. εἰ Κῦρος ἦλθεν, αὐτὸν ἂν εἶδον.* Translate these two sentences and explain the difference between them.

10. *τοῦτο ποιήσας ἀπέθανε. ὁ τοῦτο ποιήσας ἀπέθανε. δῆλος ἦν τοῦτο ποιήσας.* Translate and explain the different uses of the participle.

II. Xenophon.

1. *Translate:*

Παρεκάλεσα ὑμᾶς, ἀνδρες φίλοι, ὅπως σὺν ὑμῖν βουλευόμενος ὅ τι δίκαιόν ἐστι καὶ πρὸς θεῶν καὶ πρὸς ἀνθρώπων, τοῦτο πράξω περὶ Ὀρόντα τουτονί. τοῦ-

τον γὰρ πρῶτον μὲν ὁ ἐμὸς πατὴρ ἔδωκεν ὑπήκοον εἶναι ἐμοί· ἐπεὶ δὲ ταχθείς, ὡς ἔφη αὐτός, ὑπὸ τοῦ ἐμοῦ ἀδελφοῦ οὗτος ἐπολέμησεν ἐμοὶ ἔχων τὴν ἐν Σάρδεσιν ἀκρόπολιν, καὶ ἐγὼ αὐτὸν προσπολεμῶν ἐποίησα ὥστε δόξαι τούτῳ τοῦ πρὸς ἐμὲ πολέμου παύσασθαι, καὶ δεξιὰν ἔλαβον καὶ ἔδωκα.

Explain the construction of *πράξω, δόξαι, πολέμου.*

2. *Translate:*

Καὶ Ξενοφῶν μὲν καὶ οἱ σὺν αὐτῷ εἰπόντες τοῖς ἀσθενοῦσιν, ὅτι τῇ ὑστεραίᾳ ἥξουσί τινες ἐπ' αὐτούς, πορευόμενοι πρὶν τέτταρα στάδια διελθεῖν ἐντυγχάνουσιν ἐν τῇ ὁδῷ ἀναπαυομένοις ἐπὶ τῆς χιόνος τοῖς στρατιώταις ἐγκεκαλυμμένοις, καὶ οὐδὲ φυλακὴ οὐδεμία καθειστήκει· καὶ ἀνίστασαν αὐτούς. οἱ δ' ἔλεγον, ὅτι οἱ ἔμπροσθεν οὐχ ὑποχωροῖεν. ὁ δὲ παριὼν καὶ προπέμπων τῶν πελταστῶν τοὺς ἰσχυροτάτους ἐκέλευσε σκέψασθαι, τί εἴη τὸ κωλῦον. οἱ δ' ἀπήγγελλον, ὅτι ὅλον οὕτως ἀναπαύοιτο τὸ στράτευμα.

Explain the construction of *διελθεῖν, ὑποχωροίεν, εἴη.* Where is *ἀνίστασαν* made? *κωλῦον*?

III. Xenophon, at Sight.

Κατανενόηκας, ἔφη, ὦ Περίκλεις, ὅτι πρόκειται τῆς χώρας ἡμῶν ὄρη μεγάλα, καθήκοντα ἐπὶ τὴν Βοιωτίαν, δι' ὧν εἰς τὴν χώραν εἰσοδοι στεναί τε καὶ προσάντεις εἰσίν; Καὶ μάλα, ἔφη. ἐκεῖνο δ' ἀκήκοας, ὅτι Μυσοὶ καὶ Πισίδαι ἐν τῇ βασιλέως χώρᾳ κατέχοντες ἐρυμνὰ πάνυ χωρία καὶ κούφως ὡπλισμένοι δύνανται πολλὰ μὲν τὴν βασιλέως χώραν καταθέοντες κακοποιεῖν, αὐτοὶ δὲ ζῆν ἐλεύθεροι.

κατανοέω, observe. *πρόκειμαι*, lie in front of.
προσάντης, steep. *καὶ μάλα*, yes indeed.

IV. Homer.

1. *Translate:*

εὖδεις, Ἀτρέος υἱὲ δαΐφρονος ἱπποδάμοιο;
οὐ χρὴ παννύχιον εὕδειν βουλήφορον ἄνδρα,
ᾧ τ' λαοί τ' ἐπιτετραφαται καὶ τόσσα μέμηλεν.
νῦν δ' ἐμέθεν ξύνες ὦκα· Διὸς δέ τοι ἄγγελός εἰμι,
ὅς σευ ἀνευθεν ἐὼν μέγα κήδεται ἠδ' ἐλεαίρει.
θωρῆξαί σ' ἐκέλευσε κάρη κομόωντας Ἀχαιοὺς
πανσυδίῃ· νῦν γάρ κεν ἑλοις πόλιν εὐρυάγυιαν
Τρώων.

By whom were these words uttered? To whom? With what result? Give the Attic forms of *Ἀτρέος, ἐπιτετράφαται, ἐμέθεν, ἐών.* Where is *ξύνες* made? From what present?

2. *Translate:*

ὄρσεο, Λαομεδοντιάδη, καλέουσιν ἄριστοι
Τρώων θ' ἱπποδάμων καὶ Ἀχαιῶν χαλκοχιτώνων
ἐς πεδίον καταβῆναι, ἵν' ὅρκια πιστὰ τάμητε.
αὐτὰρ Ἀλέξανδρος καὶ ἀρηίφιλος Μενέλαος
μακρῆς ἐγχείῃσι μαχήσοντ' ἀμφὶ γυναικί·
τῷ δέ κε νικήσαντι γυνὴ καὶ κτήματ' ἔποιτο.

3. *Arrange in a hexameter line:*

Μενοιτιάδη, ἑτάροισιν, ἥιε, οἷς, σύν, καί, τε.

V. Greek History.

1. State what you know of the governments of Athens and of Sparta at the time of the outbreak of the Peloponnesian War.

2. What changes of government took place in Greece between the Homeric and the historic periods?

3. Arrange in chronological order: Alexander the Great, Aristotle, Miltiades, Pericles, Plato, Socrates, Solon.

4. By how many years did Cyrus the Great precede the younger Cyrus? What was the relationship between them? What claim had the younger Cyrus to the throne?

5. Tell the story of the Athenian Expedition against Syracuse.

STUDENTS.

A.C.—Analytical Chemistry.
C.E.—Civil Engineering.
Clas.—Classical.
E.E.—Electrical Engineering.
E.M.—Mining Engineering.
Geol.—Geology.
L.S.—Latin-Scientific.
M.E.—Mechanical Engineering.
Met.—Metallurgical Engineering.
Sci.—Science and Letters.

The names in the following lists include all the students who have registered and attended recitations at the University for the current year:

GRADUATE STUDENTS.

	For Degree.	Residence.
Charles Estell Dickerson, B.S.,	M.S.,	Mount Hermon, Mass.
Herbert Charles Dilliard, C.E.,	M.S.,	East Bangor.
Ernesto Franco, C.E.,	M.S.,	Quito, Ecuador.
Henry Kemmerling, C.E.,	M.S.,	Scranton.
E. Williamson Miller, E.M.,	M.E.,	South Bethlehem.
Albert George Rau, B.S.,	M.S.,	Bethlehem.
Martin Shaaff Stockett, B.A.,	M.A.,	Dingman's Ferry.

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Robert Montgomery Bird,	M.E.,	South Bethlehem.
William Taggart Carpenter,	C.E.,	Pittston.
John Atkinson Cunningham,	E.E.,	Henderson, Ky.
James Mitchell Daniel, jr.,	E.M.,	Paris, Tex.
Alpha Albert Diefenderfer,	A.C.,	Allentown.
Gavin Hogg Dortch,	EE.,	Goldsboro, N.C.
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Cástulo Gallardo,	C.E.,	Guadalajara, Mex.

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Felix Golian,	C.E.,	Phoenixville.
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Robert Franklin Gross,	E.M.,	Bethlehem.
Maximilian Showzo Hachita,	E.M.,	Sanuki, Japan.
William Rankin Hall,	C.E.,	Middletown, Del.
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Warren Courtland Macfarlane,	E.E.,	Louisville, Ky.
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Jonathan Emmett Sheesley,	L.S.,	Penbrook.
Stewart Sumner Shive,	E.E.,	York.
Maynard Parker Shoemaker,	M.E.,	Tenallytown, D.C.
Clarence Simpson,	M.E.,	Dover, N.J.
Marvin White Singer,	M.E.,	South Bethlehem.
Francis Peirce Sinn,	E.M.,	Germantown.
Walter Souder Slifer,	C.E.,	Lansdale.
Augustus Williston Smith,	M.E.,	Attica, N.Y.
John Clayton Snyder,	C.E.,	Harrisburg.
Harry William Spahn,	E.E.,	Lebanon.
Arthur Vall Spinosa,	C.E.,	San Juan, Porto Rico.
Raymond John Spooner,	M.E.,	East Aurora, N.Y.
Crist Harvey Stevick,	M.E.,	Harrisburg.
Christian E. Stiver,	M.E.,	Nazareth.
John Ledyard Talcott,	E.M.,	Buffalo, N.Y.
Ralph Lucas Talley,	L.S.,	Williamsport.
Harold Reiss Tracy,	A.C.,	Washington, D.C.
Jesse Wagener Underwood,	M.E.,	Washington, D.C.
Hugh Gaston VanderVeer,	C.E.,	Somerville, N.J.
Joseph Franklin Wagner,	M.E.,	Drifton.
Richard Wahle,	E.E.,	Buffalo, N.Y.
Harry Samuel Walker,	M.E.,	South Bethlehem.
Swinton Ball Waring,	C.E.,	Charleston, S.C.
Edgar C. Weinsheimer,	E.M.,	Allentown.
William Henry Welker,	A.C.,	Red Hill.
Arthur James Weston,	Clas.,	Scranton.
Emery Stone Whitney, jr.,	C.E.,	Allentown.
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Charles Ernest Yost,	C.E.,	Middletown.

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Addison Cooke Armstrong,	C.E.,	Sudbrook Park, Md.
John R. Bachman,	M.E.,	Hellertown.
William Aaron Bachman,	M.E.,	South Bethlehem.
Haro ɹ Provost Balston,	M.E.,	Flushing, L.I.
Wilson S. Barley,	C.E.,	Steelton.
Walter Carl Benedict,	C.E.,	Scranton.
Azzel Clark Bennett,	M.E.,	Oneida, N.Y.
James Foster Bennett,	C.E.,	Towanda.
E. C. Bentley,	M.E.,	Jackson, O.
John Daniel Berg,	M.E.,	Pittsburg.
Lewis S. Birely,	C.E.,	York Road, Md.
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Louis Frederick Blume,	E.E.,	Philadelphia.
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Wilson Swartz Heckler,	C.E.,	Lansdale.
Runkle Hegeman,	Clas.,	Bethlehem.
James Hemphill,	Met.,	Pittsburg.
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Frank Anderson Henry,	M.E.,	Annapolis, Md.
William James Herbert,	Clas.,	Pottsville.
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Benjamin Hartley Hewit,	C.E.,	Hollidaysburg.
William Corcoran Hill,	M.E.,	Pittsburg.
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Robert Garnett Hodgkin,	L.S.,	Falls Church, Va.
Henry William Hoeke,	M.E.,	Washington, D.C.
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Ray C. Kautz,	E.M.,	Moweaqua, Ill.
Charles Magnus Kelly,	E.M.,	Baltimore, Md.
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Harry O. Koch,	C.E.,	Tamaqua.
Ray H. Kressler,	M.E.,	Allentown.
Michael Henry Kuryla,	M.E.,	Elmira, N.Y.
J. Clinton Landefeld,	M.E.,	Ashland.
Ralph Worrall Landmesser,	M.E.,	Wilkes-Barre.

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George Landrus,	E.M.,	Wellsboro.
Will Larkin,	M.E.,	Butler.
Joseph Lough Larmour,	M.E.,	Upper Falls, Md.
George Newton Lauer,	C.E.,	Lansford.
Richard Smith Leaming,	C.E.,	South Dennis, N.J.
Raymond Miller Leffler,	A.C.,	Reading.
James Fulton Leonard,	C.E.,	Salisbury, Md.
William Henry Lesser,	M.E.,	Upper Lehigh.
John Calvin Little, jr.,	C.E.,	Parkton, Md.
Thomas Henry Lowery,	C.E.,	Bernardsville, N.J.
Paul Jacob Luckenbach,	C.E.,	Bethlehem.
George Omer Lundy,	E.M.,	Williamsport.
William Henry Lynch, jr.,	C.E.,	Harrisburg.
Robert Howard Lyon,	M.E.,	Baltimore, Md.
Ray Hope MacFetridge,	M.E.,	Hokendauqua.
Roswell Silas McMullen,	C.E.,	Carbondale.
James Joseph MacNamara,	A.C.,	Oneida.
Irving Spinney Marks,	A.C.,	Bethlehem.
Wallace Martin,	Clas.,	Paterson, N.J.
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Richard Mansfield Merriman,	C.E.,	South Bethlehem.
George Stickle Mervine,	E.E.,	Philadelphia.
Thomas Benjamin Mickley,	C.E.,	Ballietsville.
Ernest Stanley Miller,	C.E.,	Utica, N.Y.
Harry Dixon Miller,	M.E.,	Pittsburg.
John Galt Miller,	M.E.,	Lyons, Kas.
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George Holstein Morris,	E.E.,	Philadelphia.
Willis Groff Moyer,	E.E.,	Souderton.
Arthur Frederic Murray,	M.E.,	Bethlehem.
Hugh Zollinger Nead,	E.E.,	Harrisburg.
Herbert Balderston Nelson,	E.E.,	Philadelphia.
Hugh Pigott Oram,	C.E.,	Washington, D.C.
William Emrick Ostermaier,	M.E.,	Pittsburg.
Milton Cooper Pascoe,	C.E.,	Coopersburg.
Willard Marsh Payne,	A.C.,	Elmira, N.Y.
Nathaniel Ramsay Pennypacker,	E.M.,	Haddonfield, N.J.
Henry Laffayette Pentz,	M.E.,	Montoursville.
Harry Alexander Peyton,	E.M.,	Washington, D.C.

	Course.	Residence.
Earl Victor Phelps,	E.E.,	Washington, D.C.
Henry Stebbins Phillips,	A.C.,	Lowville, N.Y.
Cecil Walter Wm. Hugh Pocock,	E.M.,	Bayonne, N.J.
Raymond Myles Pownall,	E.E.,	Lansdale.
Harry W. Protzeller,	E.E.,	Hokendauqua.
Charles Reed Pulford,	C.E.,	Elmira, N.Y.
Samuel Arthur Pulford,	C.E.,	Elmira, N.Y.
Francis Rogers Pyne,	E.E.,	Elizabeth, N.J.
Henry Bidlack Reed, jr.,	M.E.,	Milford.
Joseph Walker Reed,	E.E.,	Meyersdale.
Robert Henry Reed,	M.E.,	West Bethlehem.
George Kunkel Reel,	Met.,	Harrisburg.
Henry Slicer Regester, jr.,	E.E.,	Baltimore, Md.
Willis Bertrand Reinke,	M.E.,	Kingston, Jamaica.
Richard Roy Renner,	C.E.,	Sharpsburg, Md.
Edwin Louis Rich,	E.E.,	Washington, D.C.
Edwin Clayton Rieser,	E.E.,	West Leesport.
Arthur Lee Rinehimer,	M.E.,	Wilkes-Barre.
Ralph Davidson Rittenhouse,	M.E.,	Scranton.
William Henry Roberts,	C.E.,	Bethlehem.
Herbert Stevens Rogers,	C.E.,	Plainfield, N.J.
Washington M. Ross,	M.E.,	Kittanning.
Richard Julian Roszel,	E.E.,	Welbourne, Va.
Clair Schaffer Royer,	M.E.,	Lebanon.
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Charles Edgar Ryder,	C.E.,	Norristown.
Ray Philips Saffold,	E.M.,	Washington, D.C.
Arnold Furman Sammis,	E.E.,	Huntington, L.I.
Alfred Lawrence Pearson Sands,	E.E.,	West Point, N.Y.
John P. Sanner,	M.E.,	Frackville.
Edmund Franklyn Saxton,	C.E.,	New York, N.Y.
George Henry Schaeffer,	E.E.,	Reading.
Edgar Henry Schmidt,	C.E.,	White Haven.
William Russell Schnabel,	C.E.,	Bethlehem.
Harry Frederic Schuler,	E.E.,	Salisbury, Md.
Alan deSchweinitz,	L.S.,	Bethlehem.
James Winfield Scott,	E.E.,	South Bethlehem.
James Alton Seacrest,	C.E.,	Upton.
Horace Schultz Seipt,	C.E.,	Worcester.
Oliver Paul Serfass,	E.E.,	South Bethlehem.

	Course.	Residence.
Charles Augustus Shaffer,	M.E.,	Harrisburg.
James Garfield Sheaffer,	A.C.,	New Castle.
Joseph Shema,	C.E.,	Baltimore, Md.
George Henry Shenberger,	M.E.,	Manchester.
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Frank Perley Howe Sholly,	M.E.,	Tyrone.
William Hershberger Shonk,	M.E.,	Plymouth.
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George Madison Smartt,	M.E.,	Chattanooga, Tenn.
Alfred Pollitt Smith,	C.E.,	Baltimore, Md.
Oliver W. Smith,	M.E.,	South Bethlehem.
Richard Hendon Smith,	E.E.,	Philadelphia.
Frank B. Snyder,	M.E.,	Mount Joy.
Ned Herbert Snyder,	M.E.,	Harrisburg.
Persifor Gybbon Spilsbury,	E.M.,	Trenton, N.J.
Aaron Starr,	M.E.,	New York, N.Y.
Harold Tuttle Stearns,	M.E.,	Wilkes-Barre.
George Trusdale Stevens,	A.C.,	Freeland.
John Ellsworth Stonebraker,	E.E.,	Hagerstown, Md.
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Percy R. Thomas,	M.E.,	Wilkes-Barre.
Richard Ryland Thompson,	C.E.,	Cape May, N.J.
Russell Raymond Throp,	M.E.,	Trenton, N.J.
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John Russell Wait,	M.E.,	Roselle, N.J.
Adoniram Judson Warlow,	C.E.,	South Bethlehem.
Roger Kenneth Waters,	E.E.,	Germantown, Md.
Shirley Sears Watkins,	E.E.,	Mount Carmel.
Harry Edward Weir,	E.M.,	Philadelphia.
William Allen Whaley,	M.E.,	Norfolk, Va.
Howard Matlack Wheat,	E.M.,	Louisville, Ky.
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Robert Eldredge Wilbur,	E.M.,	South Bethlehem.

Charles Wesley Williams,	M.E.,	Washington, D.C.
Albert Jones Willis,	C.E.,	Philadelphia.
James Hunter Wily,	E.E.,	Pughtown.
James Harold Wolfe,	M.E.,	Philadelphia.
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Charles Harold Young,	Clas.,	Floyd, N.Y.
Albert Wright Zahniser,	M.E.,	Mercer.

SPECIAL STUDENTS.

	Course.	Residence.
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William Frederick Berger,	M.E.,	South Bethlehem.
John Halsey Bonsall,		Dover, N.J.
Franklin Harwood Head,		Cassville, N.Y.
S. Eugene Coleman,	E.E.,	Red Creek, N.Y.
Lloyd Rahn Dunkle,	E.E.,	East Berkley.
William McCarthy Lalor,	E.E.,	Syracuse, N.Y.
Charles Irwin Lattig,		West Bethlehem.
Alfred Darte Macfarlane,	E.M.,	Kingston.
Lewis Deara Mayers,	A.C.,	Kittanning.
Colden L'Hommedien Ruggles,	M.E.,	South Bethlehem.
William F. Rust,	M.E.,	Leesburg, Va.
David Howard Smyser,	M.E.,	York.
Claude P. Stocker,	A.C.,	Bethlehem.
Joseph S. Whitehead,	E.M.,	Williamsburg.

SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	Graduates.	Seniors.	Juniors.	Sophomores.	Freshmen.	Specials.	Totals.
Classical	1	1	9	5	4		20
Latin-Scientific			1	5	5		11
Science and Letters	2	1					3
Civil Engineering	3	17	24	41	68		153
Mechanical Engineer.		7	33	41	80	4	165
Mining Engineering	1	6	5	8	20	2	42
Metallurgical Eng		3	1	2	7		13
Electrical Engineering		9	16	27	56	3	111
Analytical Chemistry.		5	5	8	12	2	32
Geology						1	1
Unclassified						3	3
Totals	7	48	94	140	250	15	554

SUMMARY OF STUDENTS BY STATES.

Massachusetts	7
Connecticut	4
New York	42
New Jersey	32
Pennsylvania	329
Delaware	4
Maryland	35
District of Columbia	30
Virginia	13
West Virginia	1
North Carolina	7
South Carolina	2
Kentucky	8
Tennessee	3
Arkansas	1
Alabama	1
Texas	3
Ohio	5
Indiana	3
Illinois	3
Michigan	1
Iowa	1
Kansas	1
Colorado	1
California	1
Indian Territory	1
Mexico	5
Cuba	1
Jamaica	2
Porto Rico	1
Ecuador	2
Peru	1
Russia	1
France	1
Japan	1
	554

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Hildebrando Barjona de Miranda, A.C., Prof. of English, Lyceo Paraence, Belém do Pará, Estades Unidos do Brazil.

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*Carl F. Zogbaum, C.E.

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Henry Richards, E.M., Contractor, Dover, N. J., P. O. Box 322.
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Owen Francis Luckenbach, M.E., Bethlehem, Pa.

Charles Joseph McGonigle, C.E., Allentown, Pa.

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Tuck Ching Strong Yen, C.E., American Bridge Co., Pencoyd, Pa. Res: 5207 Ridge Ave., Philadelphia, Pa.

Arthur Reuben Young, C.E., West Bethlehem, Pa.

The number of graduates is 1203, degrees having been conferred as follows:

Upon graduates of the School of General Literature: B.A., 54; B.S., 26; Ph.B., 7; M.A., 13.

Upon graduates of the School of Technology: C.E., 408; M.E., 265; B.S., 1; B.M., 19; B.S. (in Mining and Metallurgy), 112; E.M., 88; E.E., 168; A.C., 108; B.S. (in Architecture), 18; M.S., 10; Ph.D., 2; Met. E., 2.

Of these 12 have taken the degrees of B.A. and M.A.; 4 of B.S. and C.E.; 1 of B.S. and A.C.; 11 of B.M. and E.M.; 46 of B.S. and E.M.; 1 of B.S., B.M., and E.M.; 1 of B.M., E.M., and A.C.; 1 of B.S., E.M., and C.E.; 1 of C.E. and E.M.; 2 of A.C. and E.M.; 1 of M.E. and C.E.; 1 of M.E. and E.E.; 2 of C.E. and M.S.; 1 of E.E. and M.S.; 1 of M.E. and M.S.; 1 of A.C. and M.S.; 1 of B.S., E.M., and M.S.; 2 of A.C., M.S., and Ph.D. 1034 graduates are still living.

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Horace Musser Engle, '85, Economic Geology, Roanoke, Va.

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Daniel Henry Jenkins, '88, M.D., Physician, 1932 N. Main Ave., Scranton, Pa.

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S. W. Frescoln, '88.
L. A. Freudenberger, '01.
F. Freyhold, '85.
E. R. Frisby, '98.
G. H. Frost, '93.
F. P. Fuller, '93.
J. Fuller, '00.
W. B. Fuller, '98.
I. D. Fulmer, '97.

G

*G. L. Gabrio, '95.
L. L. Gadd, '94.
R. F. Gadd, '93.

A. G. Galan, '95.
J. M. G. Galán, '98.
F. M. Gallardo, '97.
J. G. Ganuia, '99.
T. J. Gannon, '96.
M. W. Garman, '01.
H. M. Gassman, '01.
L. P. Gaston, '88.
W. Gates, jr., '88.
C. W. Gearhart, '93.
F. B. Gearhart, '01.
R. E. L. George, '98.
E. A. Giberga y Galé, '95.
J. J. Gibson, '95.
P. D. Giess, '77.
*J. E. Gilbert, '78.
A. H. Gill, '00.
T. M. Girdler, '01.
J. B. Given, '96.
T. Gjertsen, '92.
F. W. Glading, '94.
*A. M. Glassel, '77.
*J. B. Glover, jr., '88.
E. G. Godshalk, '95.
H. H. Godshall, '93.
N. O. Goldsmith, '83.
O. S. Good, '97.
R. Goodman, '90.
W. T. Goodnow, '83.
W. R. Goss, '95.
R. C. Gotwald, '86.
E. G. Grace, '99.
J. W. Grace, jr., '99.
*J. S. Graff, '96.
M. B. Graff, '94.
W. W. Graff, '01.
S. L. Graham, '93.
F. L. Grammer, '89.
W. Gratz, '98.
C. W. Gray, '81.
G. E. Greene, '90.
H. T. Greene, '00.
W. Griffith, '76.
J. S. Griggs, jr., '91.
E. A. Grissinger, '94.
R. S. Griswold, '97.
F. A. Groff, '00.
C. F. Gross, '00.
L. J. H. Grossart, '86.
W. H. Groverman, '96.
P. L. Grubb, '01.
W. B. Grubbe, '00.
*J. A. Gruver, '92.
W. Gummere, '99.
F. H. Gunsolus, '98.
B. Guthrie, '94.

H

W. N. Haas, '01.
C. W. Haines, '74.
F. T. Haines, '95.
*H. S. Haines, '87.
J. F. Halbach, '75.
B. F. Haldeman, '81.
D. Hall, '96.
W. McC. Hall, '94.
F. D. Hallock, '94
T. G. Hamilton, '95.
M. S. Hanauer, '86.
W. T. Hanly, '97.
*O. C. Hannum, '99.
A. B. Hanscom, '00.
H. Hardcastle, '88.
T. H. Hardcastle, '80.
W. G. Hare, '98.
S. T. Harleman, '01.
H. W. Harley, '90.
H. T. Harper, '84.
E. S. Harrar, '01.
G. W. Harris, '89.
L. S. Harris, '93.
G. A. Hart, '88.
W. D. Hartshorne, '74.
R. R. Harvey, '95.

S. J. Harwi, '86.
F. A. Hausman, '01.
G. S. Hayes, '91.
C. S. Haynes, '93.
R. Hazel, '98.
S. C. Hazelton, '86.
W. C. Hazlett, '78.
R. W. Heard, '93.
D. G. Hearne, '90.
R. C. H. Heck, '93.
I. A. Heikes, '85.
J. S. Heilig, '91.
W. A. Heindle, '91.
J. G. Heinz, '00.
G. M. Heller, '77.
L. Henderson, '89.
T. L. Henry, '95.
A. W. Henshaw, '94.
A. A. Herr, '74.
H. N. Herr, '96.
J. F. Hersh, '91.
H. B. Hershey, '98.
H. D. Hess, '96.
H. H. Hess, '98.
H. S. Hess, '95.
A. Y. Hesse, '94.
C. E. Hesse, '89.
H. V. Hesse, '91.
W. S. Hiester, '97.
I. M. Higbee, '95.
H. H. Hillegass, '84.
F. H. Hilliard, '94.
E. D. Hillman, '98.
W. L. Hiss, jr., '95.
J. B. Hittell, '87.
J. D. Hoffman, '83.
E. F. Hofford, '84.
W. E. Holcombe, '94.
*J. S. B. Hollinshead, '90.
A. D. Hollingsworth, '00.
M. H. Holz, '94.
M. J. Honan, '00.
P. D. Honeyman, '91.
R. B. Honeyman, '88.
G. G. Hood, '83.
R. N. Hood, '97.
J. T. Hoover, '91.
C. C. Hopkins, '82.
W. Hopkins, '95.
G L. Hoppes, '83.
H. J. Horn, '98.
G. A. Horne, '99.
L. S. Horner, '98.
R. R. Hornor, '99.
H. S. Houskeeper, '72.
F. K. Houston, '90.
J. M. Howard, '87.
F. P. Howe, '78.
M. A. DeW. Howe, '86.
R. P. Howell, '96.
A. A. Howitz, '94.
C. W. Hudson, '89.
E. M. Huggins, '00.
G. W. Hunsicker, '94.
G. C. Hutchinson, '94.

I

H. Ichikawa, '91.
D. W. Irvine, '95.
H. T. Irwin, '97.

J

G. R. Jackson, '99.
W. S. Jackson, '96.
C. B. Jacobs, '95.
E. A. Jacoby, '95.
H. S. Jacoby, '77.
W. L. Jacoby, '92.
W. A. James, '95.
J. A. Jardine, '84.
H. S. Jaudon, '95.
S. H. Jencks, '88.
*G. A. Jenkins, '70.
A. P. Jenks, '97.

A. B. Jessup, '95.
A. E. Jessup, '92.
J. T. Jeter, '80.
J. J. Jimenez, '92.
E. B. John, '95.
A. T. Johnson, '99.
H. S. Johnson, '97.
V. A. Johnson, '96.
A. Johnston, '89.
A. B. Jones, '94.
B. H. Jones, '94.
C. C. Jones, '87.
H. H. Jones, '97.
A. E. Juhler, '91.
E. P. Jump, '01.
C. A. Junken, '86.

K

A. S. Kappella, '95.
D. Kautz, '95.
W. H. Kavanaugh, '94.
W. B. Keim, '95.
C. L. Keller, '93.
J. S. Kellogg, jr., '89.
J. W. Kellogg, '84.
H. Kemmerling, '91.
J. M. S. Kerlin, '89.
D. G. Kerr, '84.
W. J. Kerr, '70.
E. A. Keys, '99.
H. E. Kiefer, '92.
W. F. Kiesel, jr., '87.
R. Kimball, '99.
C. F. King, '80.
H. E. Kip, '95
R. R. Kitchel, '92.
J. W. Kittrell, '87.
A. W. Klein, '99.
J. H. Klinck, '99.
V. W. Kline, '96.
*L. E. Klotz, '72.
H. M. Knapp, '91.
F. N. Kneas, '98.
R. W. Knight, '94.
F. H. Knorr, '87.
S. B. Knox, '93.
B. G. Kodjbanoff, '98.
J. deB. Kops, '83.
J. B. Krause, '98.
L. G. Krause, '01.
R. E. Kresge, '96.
W. V. Kulp, '90.
H. M. Kurtz, '90.

L

S. W. Labrot, '92.
D. H. Lackey, '95.
N. Lafon, '78.
P. A. Lambert, '83.
S. E. Lambert, '89.
W. A. Lambert, '95.
O. M. Lance, '72.
H. K. Landis, '90.
R S. Landron, '99.
C. A. Langdon, '94.
*S. D. Langdon, '87.
F. B. Langston, '84.
W. Langston, '84.
L. E. Lannan, '95.
G. L. de Lara, '86.
R. E. Laramy, '96.
W. A. Lathrop, '75.
S. T. Laubach, '01.
A. R. Laubenstein, '01.
F. C. Lauderburn, '91.
E. H. Lawall, '82.
J. P. S. Lawrance, '73.
T. H. Lawrence, '98.
J. W. Ledoux, '87.
L. R. Lee, '97.
H. Lefevre, '92.
J. E. Leibfried, '00.
G. C. Leidy, '00.
H. D. Leopold, '94.

C. McK. Leoser, jr., '91.
T. S. Leoser, '90.
W. G. Lessig, '00.
A. E. Lewis, jr., '88.
A. H. Lewis, '95.
G. Lewis, '95.
H. S. Lewis, '00.
T. Lewis, '97.
J. J. Lincoln, '89.
G. B. Linderman, '87.
R. P. Linderman, '84.
J. B. Lindsey, jr., '98.
A. E. Lister, '92.
J. E. Litch, '90.
F. J. Littell, '99.
J. E. Little, '94.
C. V. Livingston, '97.
W. J. Lloyd, '92.
J. Lockett, '89.
B. W. Loeb, '95.
F. S. Loeb, '93.
A. Long, '89.
A. F. Loomis, '97.
B. E. Loomis, '96.
C. A. Loomis, '98.
J. T. Loomis, '92.
W. Lord, '96.
T. P. Lovering, '95.
C. A. Luckenbach, '86.
C. O. Luckenbach, '94.
O. F. Luckenbach, '01.
T. W. Lukens, '00.
C. E. T. Lull, '00.
W. A. Lydon, '86.

M

J. B. MacBride, '96.
C. S. MacCalla, '96.
W. H. MacCarthy, '71.
W. T. McCarthy, '00.
H. D. McCaskey, '93.
H. H. McClintic, '88.
M. McClung, jr., '94.
J. A. McClurg, '91.
K. W. McComas, '00.
W. A. McFarland, '88.
C. W. Macfarlane, '76.
C. J. McGonigle, '01.
G. K. McGunnegle, '99.
H. L. McIlvain, '88.
R. A. McKee, '95.
C. L. McKenzie, '93.
F. A. McKenzie, '95.
S. T. McKenzie, '95.
O. G. MacKnight, '99.
B. MacNutt, '97.
J. D. McPherson, '94.
W. G. McVey, '00.
J. S. Mack, '88.
C. E. Maeder, '00.
R. W. Mahon, '76.
J. J. deG. Malcher, '76.
H. L. Manley, '92.
W. P. Marr, '93.
C. D. Marshall, '88.
L. H. Marshall, '98.
J. F. Marsteller, '77.
J. VanS. Martenis, '94.
C. E. Martinez, '01.
J. J. Martin, '89.
J. P. Martin, '00.
J. G. Mason, '97.
N. P. Massey, '95.
C. M. Masson, '99.
R. S. Masson, '92.
V. E. Masson, '96.
J. O. Mathewson, '94.
A. S. Maurice, '93.
C. F. Maurice, '95.
G. H. Maurice, '93.
A. E. Meaker, '75.
W. L. Meaker, '99.
W. A. Megraw, '97.
H. S. Meily, '87.

L. D. Menough, '01.
E. A. Mercenario, '97.
J. F. Merkle, '84.
F. A. Merrick, '91.
*W. S. Merrill, '94.
T. Merriman, '97.
T. Merritt, '74.
J. F. Middledith, '99.
E. J. Millar, '92.
Charles Henry Miller, '88.
*Charles Henry Miller, '89.
Charles Herbert Miller, '90.
E. F. Miller, '83.
E. W. Miller, '96.
G. P. Miller, '88.
J. E. Miller, '93.
J. S. Miller, '95.
J. Z. Miller, '91.
W. H. Miller, '94.
*J. H. Millholland, '88.
P. D. Millholland, '86.
H. S. Miner, '88.
H. B. de Miranda, '73.
R. F. de Miranda, '72.
*S. Miyahara, '77.
C. W. Moffett, '89.
C. A. Moore, '94.
H. J. Moore, '01.
M. de la Mora, '00.
R. de la Mora, '96.
W. F. More, '83.
C. H. Morgan, '96.
J. F. Morgan, '99.
*C. F. Moritz, '98.
A. D. Morris, '95.
H. T. Morris, '91.
R. H. Morris, jr., '89.
W. E. Morris, '89.
J. Morrison, '75.
G. R. Morrow, '00.
H. S. Morrow, '88.
J. A. Morrow, '87.
J. T. Morrow, '89.
N. Morrow, '83.
R. T. Morrow, '82.
C. T. Mosman, '92.
D. L. Mott, '88.
F. D. Mount, '97.
E. T. Murphy, '01.
W. S. Murray, '95.
W. H. Mussey, '96.
H. K. Myers, '84.
J. H. Myers, '96.
W. F. Mylander, '93.

N

C. P. Nachod, '97.
G. Nauman, jr., '90.
W. L. Neill, '88.
R. Neilson, '95.
H. S. Neiman, '88.
J. L. Neufeld, '94.
C. W. F. Neuffer, '94.
R. E. Neumeyer, '90.
C. A. Newbaker, '94.
C. G. Newton, '99.
H. H. Newton, '97.
D. K. Nicholson, '85.
T. Nicholson, '83.
*H. B. C. Nitze, '87.
R. C. Noerr, '97.
J. T. Nolan, '01.
B. B. Nostrand, jr., '78.
A. R. Nuncio, '84.

O

J. A. de Obaldia, '98.
A. D. Oberly, '89.
F. Oberly, '96.
R. L. Ogden, '94.
J. F. O'Hearn, '94.
W. R. Okeson, '96.
C. L. Olmsted, '93.
L. A. Olney, '96.

R. B. Olney, '92.
J. M. O'Malley, '89.
C. J. O'Neill, '93.
G. Ordway, '94.
J. O'Reilly, '98.
H. Orth, jr., '92.
L. Ortner, '00.
N. M. Osborne, jr., '93.
R. E. Ozias, '92.

P

J. W. Packard, '84.
*H. E. Packer, '70.
H. C. Paddock, '98.
*J. H. Paddock, '79.
P. M. Paine, '91.
*H. Palmer, '88.
H. L. Palmer, '96.
H. R. Palmer, '99.
M. P. Paret, '78.
C. J. Parker, '88.
C. W. Parkhurst, '93.
A. R. Parsons, '00.
D. W. Patterson, '93.
G. S. Patterson, '83.
W. A. Payne, '94.
R. R. Peale, '83.
E. J. Peck, '01.
*H. R. Peck, '97.
J. G. Peck, '93.
F. S. Pecke, '75.
J. H. Pennington, '97.
W. C. Perkins, '90.
F. A. Perley, '98.
R. S. Perry, '88.
*F. B. Petersen, '85.
J. G. Petrikin, '96.
G. F. Pettinos, '87.
J. R. Pettit, '99.
W. V. Pettit, '94.
J. H. Philips, '95.
A. E. Phillips, '90.
J. Phillips, jr., '95.
R. H. Phillips, '87.
F. W. B. Pile, '88.
C. Platt, '90.
J. S. Polhemus, '72.
*R. K. Polk, '87.
C. P. Pollak, '87.
M. W. Pool, '96.
H. F. J. Porter, '78.
R. H. E. Porter, '89.
H. A. Porterfield, '83.
A. Potter, '90.
G. E. Potter, '80.
S. C. Potts, '94.
J. L. Poultney, '95.
N. S. Powell, '00.
E. W. Pratt, '90.
M. D. Pratt, '87.
H. R. Price, '70.
J. B. Price, '85.
E. J. Prindle, '90.
F. H. Purnell, '83.
M. H. Putnam, '97.

Q

C. W. Quarrier, '98.
E. A. Quier, '91.
H. C. Quigley, '95.

R

L. T. Rainey, '99.
F. DeW. Randolph, '92.
R. B. F. Randolph, '93.
W. K. Randolph, '78.
*J. L. Rankin, '96.
R. S. Rathbun, '92.
A. G. Rau, '88.
C. R. Rauch, '77.
C. E. Raynor, '88.
R. H. Read, '78.
J. J. Reamer, '00.
V. C. Records, '98.

H. B. Reed, '70.
H. P. Reed, '96.
Percy Lawrence Reed, '98.
Percy Leslie Reed, '99.
W. M. Rees, '74.
A. K. Reese, '89.
J. N. Resse, '00.
*A. S. Reeves, '84.
H. A. Reid, '96.
J. G. Reid, '93.
V. H. Reid, '99.
W. Reinecke, jr., '95.
E. T. Reisler, '87.
H. G. Reist, '86.
W. F. Rench, '91.
J. W. Reno, '83.
E. C. Reynolds, '93.
J. P. Reynolds, jr., '97.
S. A. Rhodes, '92.
W. P. Rice, '76.
F. E. Richards, '93.
G. T. Richards, '87.
H. Richards, '76.
J. W. Richards, '86.
L. W. Richards, '76.
W. P. Richards, '88.
G. M. Richardson, '86.
O. Rickert, '88.
E. Ricksecker, '82.
W. C. Riddick, '90.
B. DeW. Riegel, '98.
J. I. Riegel, '92.
J. S. Riegel, '90.
S. S. Riegel, '97.
E. J. Rights, '95.
H. T. Rights, '95.
G. W. Ritchey, '93.
S. N. Riter, '95.
*M. Rock, '69.
T. C. Roderick, '94.
W. H. Rodney, '01.
F. W. Roebling, jr., '01.
A. L. Rogers, '89.
C. L. Rogers, '83.
F. W. Roller, '94.
C. E. Ronaldson, '69.
*W. D. Ronaldson, '70.
D'A. W. Roper, '98.
*A. S. Ross, '86.
J. G. Ross, '00.
E. P. Roundey, '97.
*G. Rovelo, '99.
C. E. Rowe, '00.
H. W. Rowley, '85.
W. Royce, '97.
*G. A. Ruddle, '86.
J. Ruddle, '83.
J. D. Ruff, '82.
G. H. Ruggles, '96.
C. B. Rutter, '94.
C. C. Rutter, '96.
J. C. Ryan, '01.

S

F. B. Sage, '93.
A. L. Saltzman, '97.
J. E. Sanborn, '90.
A. Sanchez, '00.
A. J. Sanchez, '01.
R. F. Sanchez, '98.
C. F. Sanders, '97.
F. W. Sargent, '79.
E. T. Satchell, '00.
W. R. Sattler, '88.
*M. L. Saulsbury, '93.
A. C. Savidge, '01.
W. H. Sayre, jr., '86.
J. A. Schloss, '93.
R. Schmitz, '91.
E. A. Schnabel, '91.
A. Schneider, '92.
H. Schneider, '94.
B. F. Schomberg, '94.
A. Schotte, '93.

C. W. Schwartz, jr., '89.
H. C. Schewecke, '98.
E. Schwinghammer, '95.
C. F. Scott, '97.
H. H. Scovil, '00.
H. D. Scudder, '72.
W. McI. Scudder, '73.
*J. W. Scull, '87.
H. H. Seabrook, '97.
B. Searle, '84.
H. K. Seltzer, '95.
W. F. Semper, '93.
J. B. Semple, '92.
L. B. Semple, '84.
S. P. Senior, '97.
A. H. Serrell, '97.
J. C. Sesser, '96.
E. E. Seyfert, '94.
J. W. Shaeffer, '01.
*W. Shapleigh, '71.
A. B. Sharpe, '93.
F. B. Sheaffer, '97.
C. K. Shelby, '92.
L. R. Shellenberger, '91.
*A. Y. Shepherd, '96.
G. E. Shepherd, '94.
D. F. B. Shepp, '98.
J. L. Sheppard, jr., '97.
H. J. Sherman, '90.
J. E. Shero, '95.
A. Shimer, '99.
I. A. Shimer, '91.
C. E. Shipley, '94.
E. H. Shipman, '88.
W. C. Shoemaker, '90.
L. D. Showalter, '96.
H. Shriver, '96.
J. C. Shriver, '92.
J. S. Shultz, '00.
E. P. Shuman, '97.
*S. B. Sickler, '82.
J. S. Siebert, '86.
R. S. Siegel, '95.
E. H. Sigison, '95.
J. B. Slack, '95.
J. E. Slade, '97.
A. P. Smith, '84.
*E. O. Smith, '85.
F. B. Smith, '97.
F. S. Smith, '87.
N. W. Smith, '93.
P. H. W. Smith, '92.
R. E. Smith, '94.
W. S. Smith, '00.
B. R. Smoot, '98.
A. M. Smyth, '89.
C. S. Snyder, '00.
E. E. Snyder, '87.
M. D. Sohon, '90.
E. A. Soleliac, '93.
A. Solorzano, '00.
F. P. Spalding, '80.
W. H. Speirs, '99.
J. H. Spengler, '86.
H. W. Sprague, '97.
M. T. Stack, '97.
E. S. Stackhouse, '86.
L. C. Starkey, '98.
W. P. Starkey, '00.
C. W. Startsman, '01.
H. S. Stauffer, '01.
*J. W. Stauffer, '98.
A. P. Steckel, '99.
E. G. Steinmetz, '95.
G. Stern, '93.
A. R. Sterner, '97.
T. Stevens, '96.
W. Alonzo Stevenson, '88.
W. Alston Stevenson, '90.
J. Stewart, '97.
M. Stewart, '84.
H. T. Stilson, '91.
W. R. Stinemetz, '93.
C. H. Stinson, '83.

*R. Stinson, '83.
J. E. Stocker, '95.
A. W. Stockett, '89.
M. S. Stockett, '98.
L. Stockton, '81.
H. H. Stoek, '87.
W. H. Stokes, '88.
H. E. Stout, '86.
R. P. Stout, '91.
H. R. Stratford, '94.
P. B. Straub, '97.
R. M. Straub, '99.
T. A. Straub, '90.
J. A. Strauss, '00.
*J. K. Surls, '86.
W. C. Swartz, '94.
F. G. Sykes, '94.
E. H. Symington, '98.
J. F. Symington, '01.
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